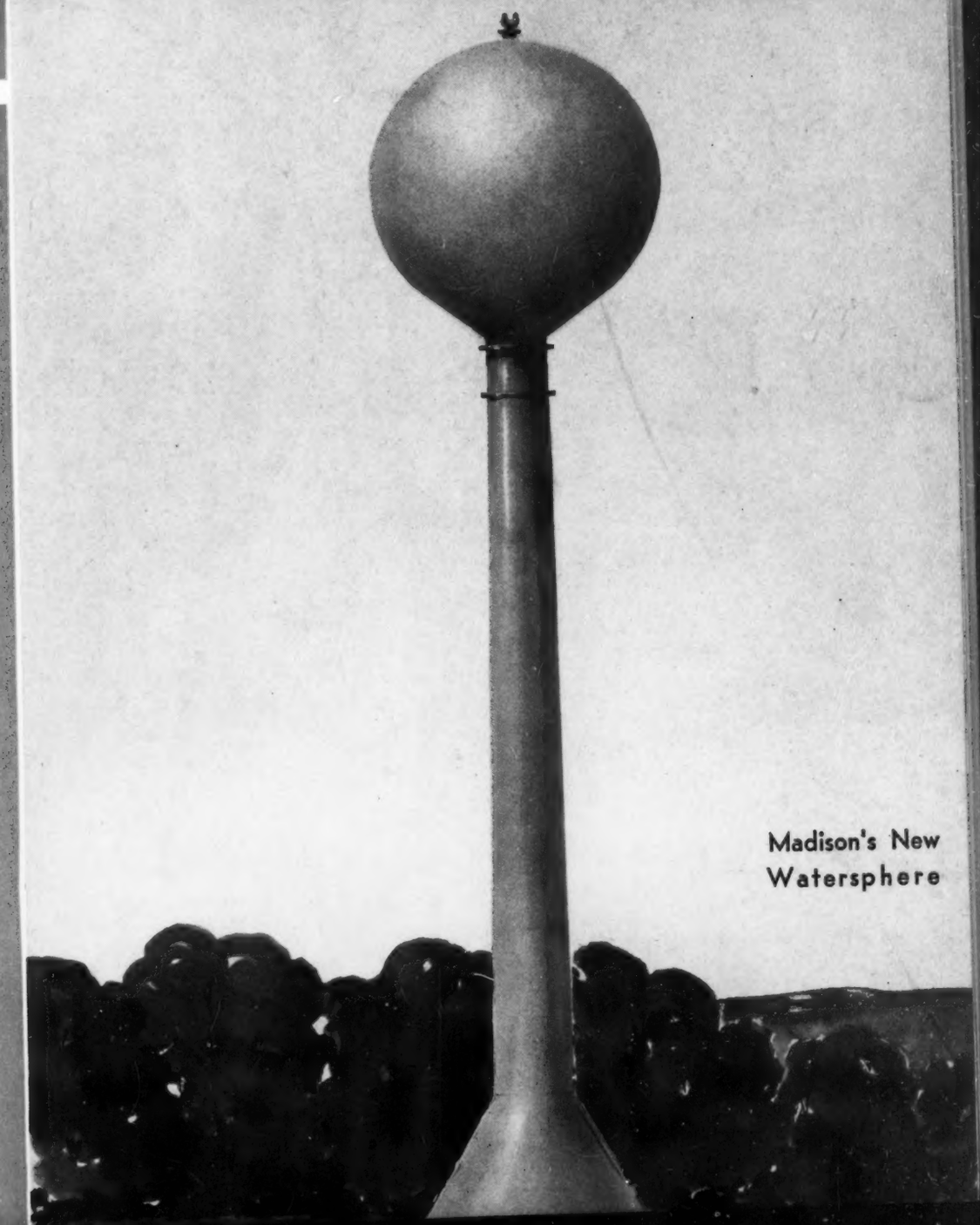
WATER WORKS & SEWERAGE

A GILLETTE ABP ABC PUBLICATION

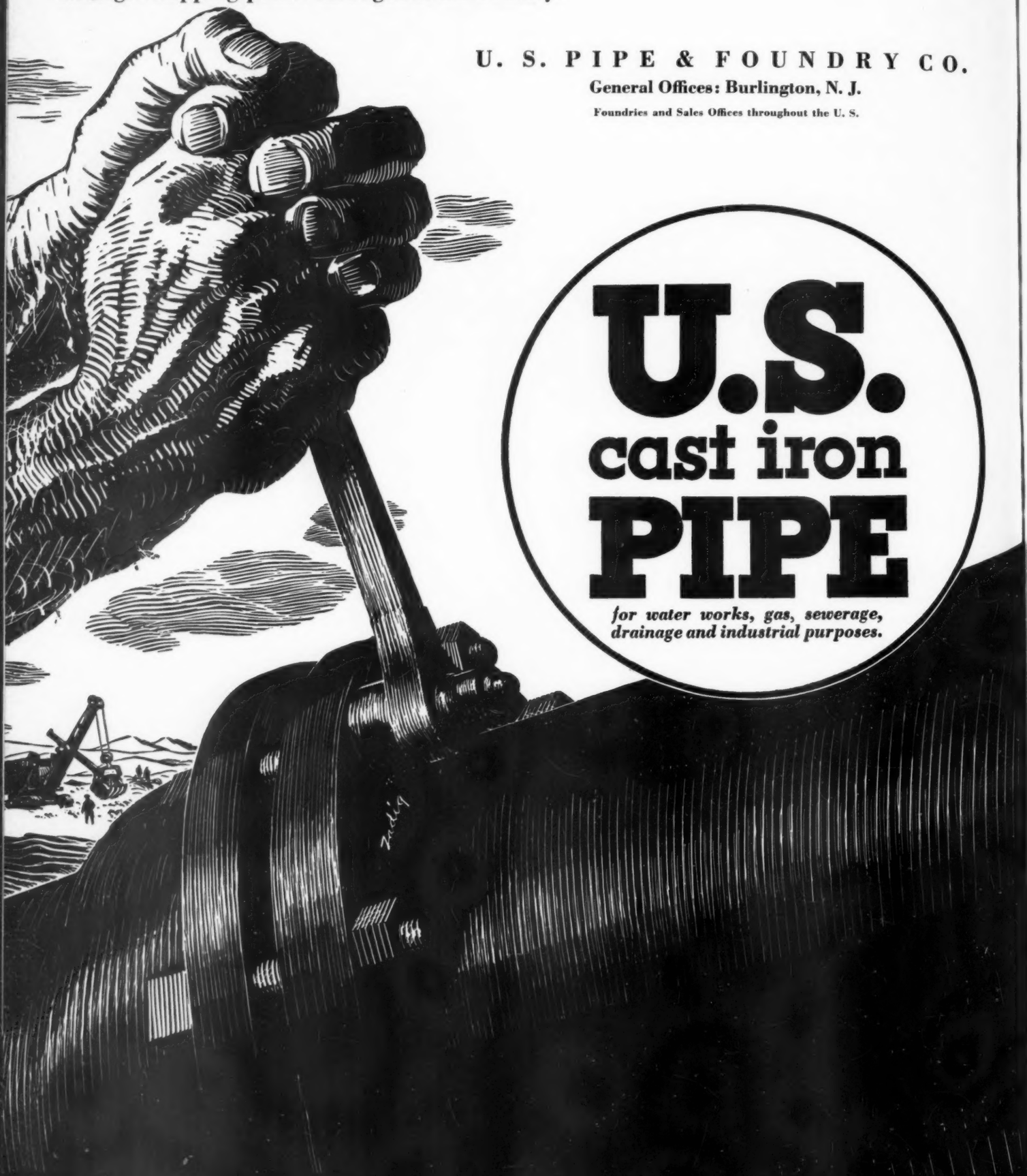


Madison's New Watersphere

MARCH
1941

VOL. 88, NO. 3

CONNECTING the pipe and assembling the joints is an easy, fast and foolproof operation with U. S. Mechanical Joint Pipe, resulting in a bottle-tight line. We have on hand large stocks of mechanical joint, bell-and-spigot and flanged Super-de Lavaud centrifugally cast pipe, pit-cast pipe and standard fittings in plant and storage yards at strategic shipping points throughout the country.



U. S. PIPE & FOUNDRY CO.

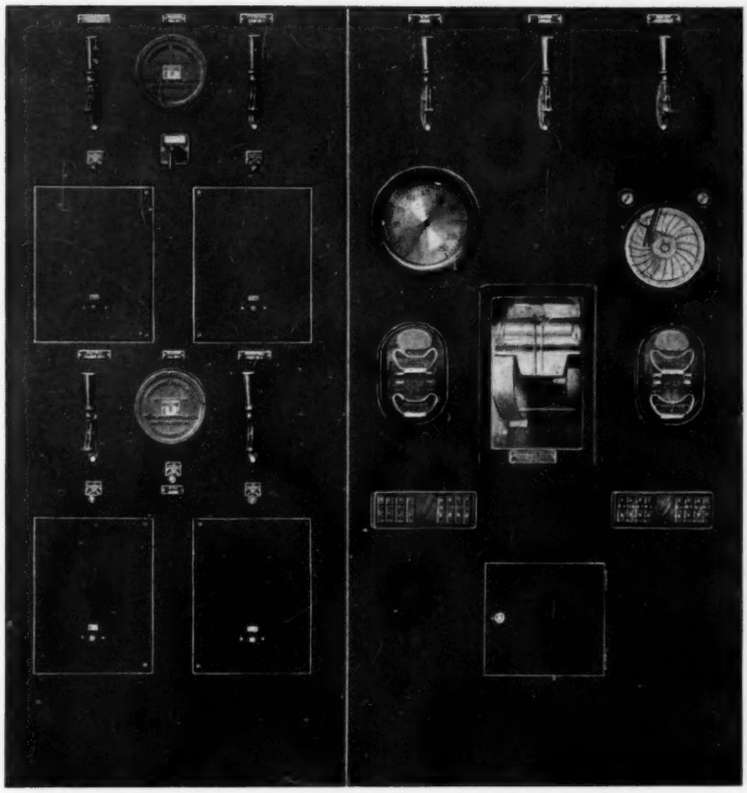
General Offices: Burlington, N. J.

Foundries and Sales Offices throughout the U. S.

U.S. cast iron PIPE

for water works, gas, sewerage, drainage and industrial purposes.

2-20 HP, & 2-30 HP, 220 VOLT, 3 PHASE, 60 CYCLE MOTORS CONTROLLED BY CLARK-SUNDH DEAD FRONT PANEL



¶ One Panel of this Dead Front Steel Switch Board houses 2-20 HP and 2-30 HP, 220 Volt, 3 phase, 60 cycle, Across-the-Line type Motor Starters, equipped with Manual Testing Switch, independent of the Automatic operation.

¶ The 2-30 HP Motors operate a deep Well Centrifugal and a Boost Pump, both Pilot Switch operated by Float Switch Control.

¶ The 2-20 HP Centrifugal Booster Pumps are operated by Pressure Control with transfer facilities for interchanging the 2 Bourdon Tube Type Regulators with the 2 motor starters.

¶ The other panel houses the incoming line, metering, recording, and lighting distribution section.

¶ All Knife Switches and Transfer Switches are externally operated without live parts on front of board, providing operator protection as well as motor protection.

¶ Typical of the neatness and efficiency of Clark-Sundh Control apparatus, this Dead-Front Steel Switch Board effectually helps keep a Mid-West city Water Works operating efficiently.

¶ For Water Works and Sewage Disposal Plant electrical control, please contact our nearest office.

OFFICES IN PRINCIPAL CITIES

THE CLARK CONTROLLER CO.

1146 EAST 152ND ST. CLEVELAND, OHIO

WATER WORKS & SEWERAGE, March, 1941. Volume 88. Number 3. Published monthly at 330 South Wells Street, Chicago, Ill., by the Gillette Publishing Company. Per copy, 25c. Subscription rate, United States $2.00 per year; Canada $2.40 per year; Foreign $3.00 per year. Copyright, 1941. Entered as Second Class Matter, June 2, 1931, at the Post Office at Chicago, Ill., under Act of March 3, 1879.

THESE ARE THE REQUIREMENTS...
CAN YOU MEET THEM?

TO INCINERATE A COMBINATION OF GREEN GARBAGE AND SEWAGE FILTER CAKE..

TO INCINERATE GREEN GARBAGE ALONE....

TO INCINERATE SEWAGE FILTER CAKE ALONE..

TO GUARANTEE PERFORMANCE...

YES! ...Said Incineration Headquarters!

INCINERATION HEADQUARTERS

... the country's most authoritative organization on all matters relating to the incineration of municipal wastes ... maintains an integrated program of laboratory study, field research and plant design, assuring only equipment that is tried and proven.

Now, let the Rock Island Argus tell the story—

"On recommendation of the committee sent to Maryland and New Jersey last week to inspect incinerators, the council awarded the Nichols Engineering and Research Corporation of New York City the contract for furnishing and installing incinerator equipment at a cost of $68,750.

The committee reported that incinerator equipment costing about $50,000 less, on which bids were received last week, was unsatisfactory. Members explained the equipment would burn garbage alone and garbage and sewer sludge combined, but would not burn sewer sludge alone, as will be necessary in Rock Island, without the use of considerable additional fuel.

Committee members, in explaining their recommendation for the purchase of the more expensive incinerator equipment, said the cheaper equipment failed to burn the sludge and garbage thoroughly and that working conditions in plants where such equipment was in operation were far from proper."

Quoted from The Rock Island Argus, 1-23-40

NICHOLS ENGINEERING & RESEARCH CORPORATION

60 WALL TOWER BLDG., NEW YORK, N. Y. NERCO UNIVERSITY TOWER BLDG., MONTREAL, P. Q.

DEFENSE COMES FIRST

To meet the needs of the National Defense Program, plus the normal demands of peace, a vast expansion of our already greatly increased production capacity is being speeded. When the emergency is past, there will be more Aluminum available than ever before.

Meanwhile, if you can't get all the Aluminum you want when you want it, remember Aluminum is helping you by helping to meet the National emergency.

Seasonal variation of sewage flow makes it possible for this sewage treatment plant to shut down a number of their aeration tanks during the winter months. This enables them to remove diffuser plates from those tanks, recondition them, and start up again in the spring with every plate working at top efficiency.

Burger Diffuser Plate Holders make this task of removing and replacing plates an easy one. Simply by loosening the holding-down bolts on each plate, that plate can be lifted off. In the spring, it is put back in place and quickly made air- and water-tight against its long-lived rubber gasket.

ALUMINUM COMPANY OF AMERICA, 1955 Gulf Building, Pittsburgh, Pennsylvania.

ALCOA ALUMINUM

You'll get positive, economical sewage coagulation with

Ferric Chloride

(anhydrous and liquid)

Ferric Chloride
(anhydrous and liquid)

is the supreme sewage coagulant for

- Sludge Dewatering
- Raw Sludge
- Raw Activated Sludge
- Digested Sludge
- Mixed Sludge
- Coagulation
- Raw Sewage
- Settled Sewage
- Industrial Sewage
- Mixed Industrial and Domestic Sewage

Ferric chloride is a positive coagulant for sewage, producing extremely clean-cut flocculation in economical doses. In most communities, ferric chloride offers substantial savings over alum.

And Pennsylvania Salt, pioneer in producing liquid ferric chloride for use in sewage disposal, has also pioneered in developing economical and effective methods of using this valuable coagulant. Our data files and engineering assistance are yours to command.

Aqueous ferric chloride varies in concentration from 39% $FeCl_3$ in extremely cold weather to 45% $FeCl_3$ in extremely hot weather. It is shipped in rubber-lined 8000-gal. tank cars, averaging 40,000 lb. of dissolved $FeCl_3$ per car.

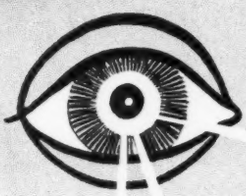
Anhydrous ferric chloride is supplied by Penn Salt in water-free form, as nearly 100% $FeCl_3$ as possible. It is shipped in non-returnable steel drums, 150 and 400 lb. sizes.

Call on us for technical service in connection with your chemical sewage treatment problems. Pennsylvania Salt Manufacturing Co., Widener Bldg., Philadelphia, Pa. — New York • Chicago • St. Louis • Pittsburgh • Wyandotte • Tacoma.

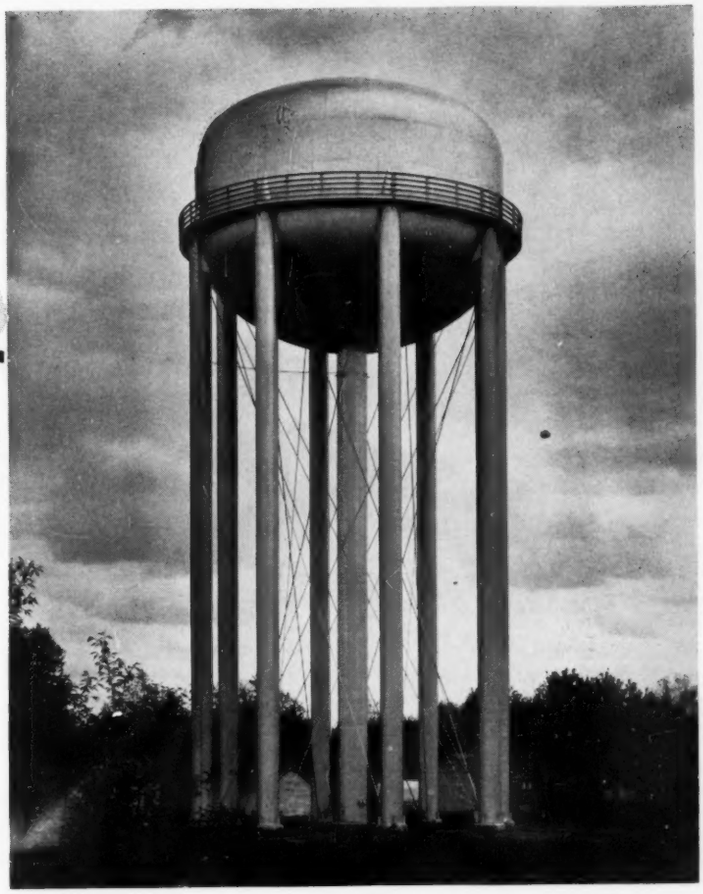
PENNSYLVANIA SALT MANUFACTURING COMPANY

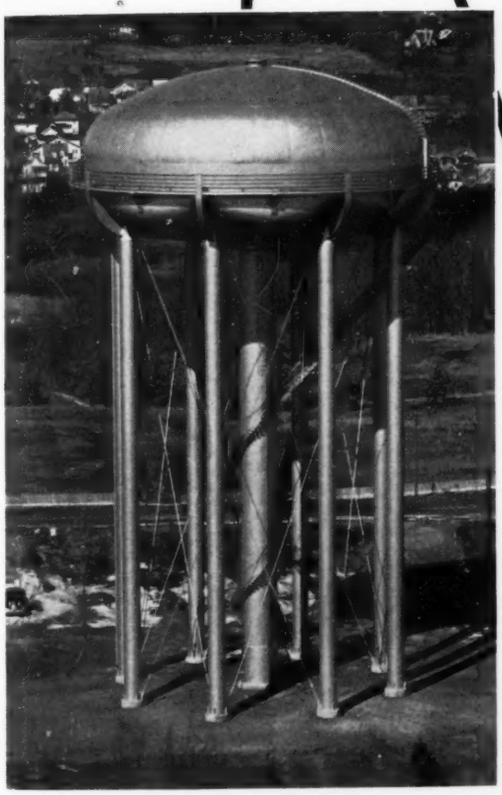
Chemicals

LOOKING AT IT



FROM ALL ANGLES





Modern

ELEVATED STORAGE is *HARD TO BEAT!*

WHEN it comes to securing more uniform distribution pressures—lower pumping costs—increased protection against fire hazard—and all around improvement in service to municipal and industrial water consumers, it's hard to beat the efficiency and economy offered through the use of modern elevated storage. The two "Colonial" design units illustrated here are typical examples of the modern attractive appearance being attained in Horton elevated storage tanks. Both tanks are installed in the Kalamazoo, Mich., water supply system. The one shown above has a capacity of 350,000 gals., and the unit at the left has a 750,000-gal. capacity. Write for complete information or quotations on Horton elevated tanks.

CHICAGO BRIDGE & IRON COMPANY

Chicago	2198 McCormick Bldg.	Birmingham	1586 North 50th Street	Philadelphia	1644-1700 Walnut St.
New York	3390-165 Broadway Bldg.	Tulsa	1646 Hunt Bldg.	Boston	1548 Consolidated Gas Bldg.
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Plants at BIRMINGHAM, CHICAGO, and GREENVILLE, PA. *In Canada:* HORTON STEEL WORKS, LIMITED, FORT ERIE, ONT.

50 years

Dr. Edward Goodrich Acheson whose inventive genius in creating the first man-made grinding material gave such impetus to the development of abrasive products that they have become all important factors in making possible vastly increased production and greater precision throughout all industry.

● Never before in history has life been so enriched by scientific discovery and industrial progress as in the half century just completed. We have seen amazing strides in means of transportation . . . the automobile, the airplane, the streamlined train of stainless steel. The electric furnace has given industry new chemicals, new steels, new alloys. We have witnessed the creation of new synthetics, the perfection of the machine tool, the enormous development of mechanical efficiency in every field and the production of countless commodities that promote and protect our way of life.

Of all these varied advances none surpass the progress made in the abrasive field. When Dr. Edward Goodrich Acheson created the first man-made abrasive fifty years ago, little did he foresee that modern abrasive products would become one of industry's most important tools for the shaping, grinding and finishing of almost every device of the useful arts. It shapes the tiny balances of our watches. It smooths the massive casting. It grinds tons of wood pulp for paper making. It fashions marble and stone, finishes wood and leather and sharpens the tools of every craft.

In other words manufactured abrasives are intimately integrated with the very structure of industrial life . . . meeting its fundamental needs, furthering its progress, translating yesterday's luxuries into today's commonplace necessities.

It is with justifiable pride, therefore, that we of The Carborundum Company pay tribute to the late Dr. Edward Goodrich Acheson in commemorating the Fiftieth Anniversary of his creation of silicon carbide, trade named "Carborundum," the first man-made abrasive. It is fitting also that we choose this occasion to acknowledge the splendid cooperation of our friends in industry in bringing his work to fruition and to rededicate this Company's efforts to a continuing service to industry and to the betterment of America's way of life.

Frank J. Tone

FRANK J. TONE, *President,*

THE CARBORUNDUM COMPANY,

NIAGARA FALLS, N. Y.

UNDERGROUND LEAKAGE . . .

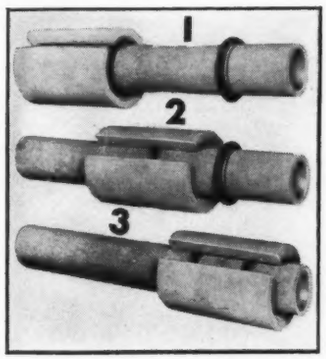
and how it can be minimized with this simple, "packaged" joint

NUMEROUS surveys have shown that leaky joints are responsible for a considerable portion of total water losses from underground mains. Generally recognized by waterworks men as a serious problem, joint leakage not only results in a direct waste of water but, by washing away supporting soil, frequently causes pipe to fracture under traffic and earth loads.

Much of this trouble is caused by the fact that the ordinary rigid joint, even though perfectly made by skilled workmen, may open up when subjected to vibration or settlement after the line is in service.

One Solution . . .

Such potential dangers are minimized with a *flexible* joint. And that is the principle upon which the Simplex Coupling, employed in assembling Transite Pipe, was designed. Consisting of a Transite sleeve and two rubber rings, it forms a tight joint that stays tight in service. Its flexibility compensates for vibration and for vertical, longitudinal and lateral movements to which the pipe may be subjected underground. Depending upon the size of the pipe, a deflection of 5° or more is possible at each joint.



Simplex Coupling Assembly
(1) At start of operation
(2) Sleeve pulled over one ring
(3) Final position, sleeve centered over joint

Simplicity—the best insurance against defective joints

From a practical standpoint, the less skill required in assembly, the less the danger of defective joints in the field. The dependability of the Simplex Coupling is due primarily to these distinctive features:

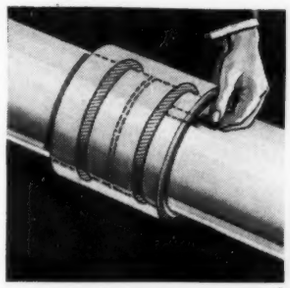
1. It is actually a pre-fabricated, "*packaged*" joint. The ends of the pipe and the inside of the coupling are machined to exact dimensions. The rubber rings are precision-made and subjected to rigid inspection before shipment. Joints are assembled cold—no pouring, caulking or heating equipment is needed. A simple hydraulic coupling puller, loaned by Johns-Manville without charge, is the only tool required for assembly.

2. The effectiveness of the joint does not depend on the individual skill or training of the workmen. So simple is the operation that perfect Simplex joints can be made quickly and economically even by completely unskilled crews.

The Simplex Coupling is assembled with a hydraulic puller. The collar engages the edge of the Transite sleeve; the jack fits over the open end of the pipe.

Made of Permanent Materials

The Transite sleeve, like the pipe itself, is made of asbestos and cement and has the same high degree of resistance to all forms of corrosion. The rings, made of the highest quality rubber, are carefully cured and specially compounded with anti-oxidents and properly graded non-hygroscopic fillers to assure permanence in water service.



With Simplex Couplings, tightness of the joint can be determined from the outside as soon as the pipe is laid. A thin steel blade, slipped under the lip of the sleeve, checks the position of the rubber ring. If the position is right, the joint is tight.

. . . and a word about Transite Pipe

Simplex Couplings, designed specifically for use with Transite Pipe, have solved the joint-leakage problem for many American municipalities. And Transite Pipe has helped bring other waterworks problems under control—tuberculation, soil corrosion and electrolysis, and the toll they exact in excessive operating and maintenance costs, to mention but a few. Full details on Transite Pipe and Simplex Couplings are in Catalog TR-11A. We'll be glad to send you a copy. Johns-Manville, 22 East 40th Street, New York, N. Y.

NOTE TO ENGINEERS: The "J-M Pipe Installation Manual," a 76-page book that outlines in detail effective methods of installing water lines, contains much more data on the Simplex Coupling than was possible to include above. A copy will be sent you on request.

Johns-Manville TRANSITE PIPE

For efficient

Over 70 years of being always ready through any weather has proved that Mathews Hydrants really are frostproof. It's shown them to be the standard of winter safety. Be sure your hydrants have these essential features:

●

The Mathews operating thread is dry—sealed against both external and internal water.

●

Frost-heaved ground cannot crack or lift a Mathews Hydrant. The ground grips only its loose protection case.

●

Water can't stand in a properly set Mathews. Its one-piece drain valve is positive and automatic.

●

Specify Mathews Hydrants. Write for prices, diagrams, or any facts you want.

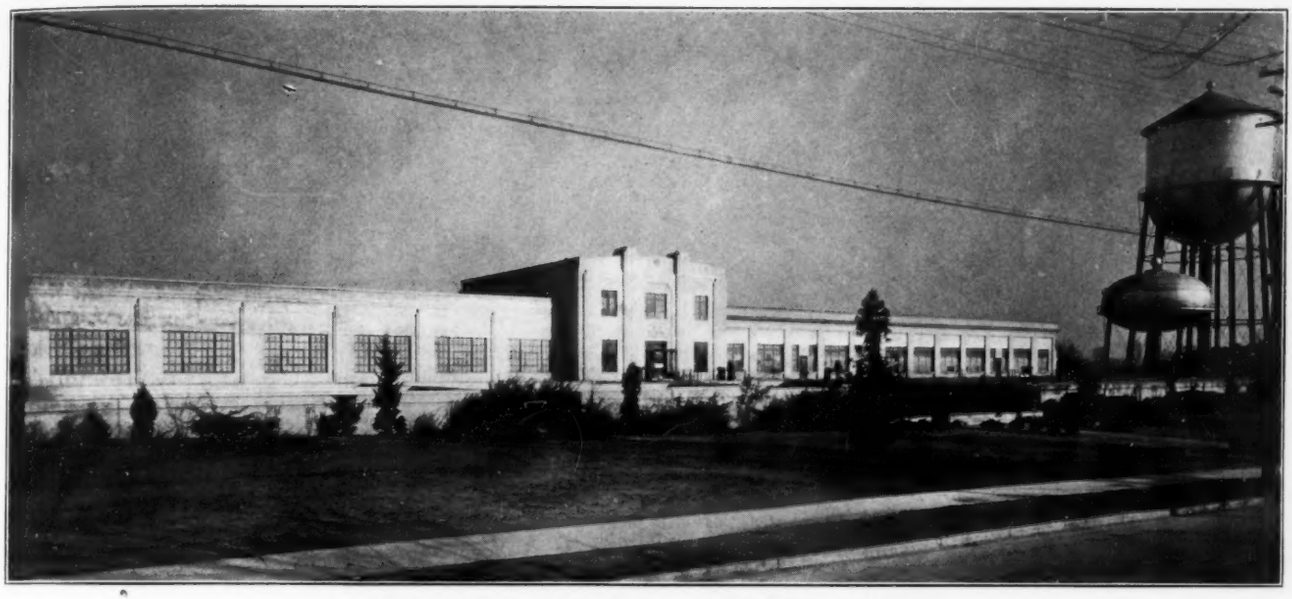
MATHEWS HYDRANTS

Made by R. D. WOOD COMPANY

Manufacturers of Sand Spun Pipe (centrifugally cast in sand molds) and R. D. Wood heavy-duty gate valves for water works

400 CHESTNUT STREET, PHILADELPHIA, PA.

Another City—USING ALL THREE



CHARLOTTE, NORTH CAROLINA PLANT

Activated Alum is pleased to announce the opening of a NEW BRANCH OFFICE in the CITY of CHARLOTTE.

BURT GRAHAM is now in charge at his new headquarters —1217 LIBERTY LIFE BUILDING.

Charlotte's modern plant pictured above operates efficiently with

ACTIVATED ALUM CHAMPION CARBON
PALMER AGITATORS

ASK FOR DETAILS DESCRIBING THESE
WATER WORKS PRODUCTS AND WHAT **ALL THREE** CAN DO FOR YOU.

Activated Alum Corp.

Curtis Bay

BALTIMORE **MARYLAND**

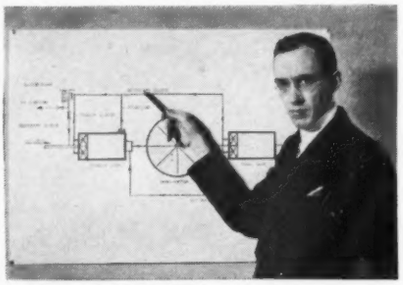
...Yes and that's not all an Aero-Filter offers!

① AERO-FILTER IS SMALLER! Filter bed volume is 1/7 to 1/9 the size of conventional filters. This is made possible because of Aero-Filter's efficient distribution of sewage to the filter bed. It also has other low-cost advantages! . . . . .

② NO COSTLY PUMPING for recirculation, nor oversize primary settling tanks are required with Aero-Filter's rain-like distribution. Maintenance and power costs are lowered. Lower initial plant cost also reduces fixed charges. . . .

③ ADEQUATE PURIFICATION for any requirement—is now available with Aero-Filters. By a choice of single or two-stage design and supplementary units, any degree of effluent quality may be secured at minimum cost. . . . . .

④ THESE 49 INSTALLATIONS in both northern and southern climates — approval by state boards of health, and several years of proved service, give conclusive evidence that Aero-Filter superiority is a well established fact among men who know. . . . . .



⑤ AND AERO-FILTER SLUDGE can be concentrated in the primary tank, combining it with the primary sludge before pumping to the digesters. This reduces to a minimum the heat loss and the supernatant solids discharge due to sludge pumping. . . . . .

⑥ REX SANITATION EQUIPMENT also includes other vital equipment for the Aero-Filter plant . . . bar screens, triturators, grit collectors and washers, conveyors, Tow-Bro sludge collectors, rapid and Slo-Mixers, etc. Get copies of catalog on those items you find interesting.

P.S. *We feel you'll be as favorably impressed with Aero-Filter as this engineer was after this imaginary conversation. Send today for an Aero-Filter catalog—also others on the complete line of Rex Sanitation Equipment. Address 1610 W. Bruce Street, Milwaukee, Wisconsin.*

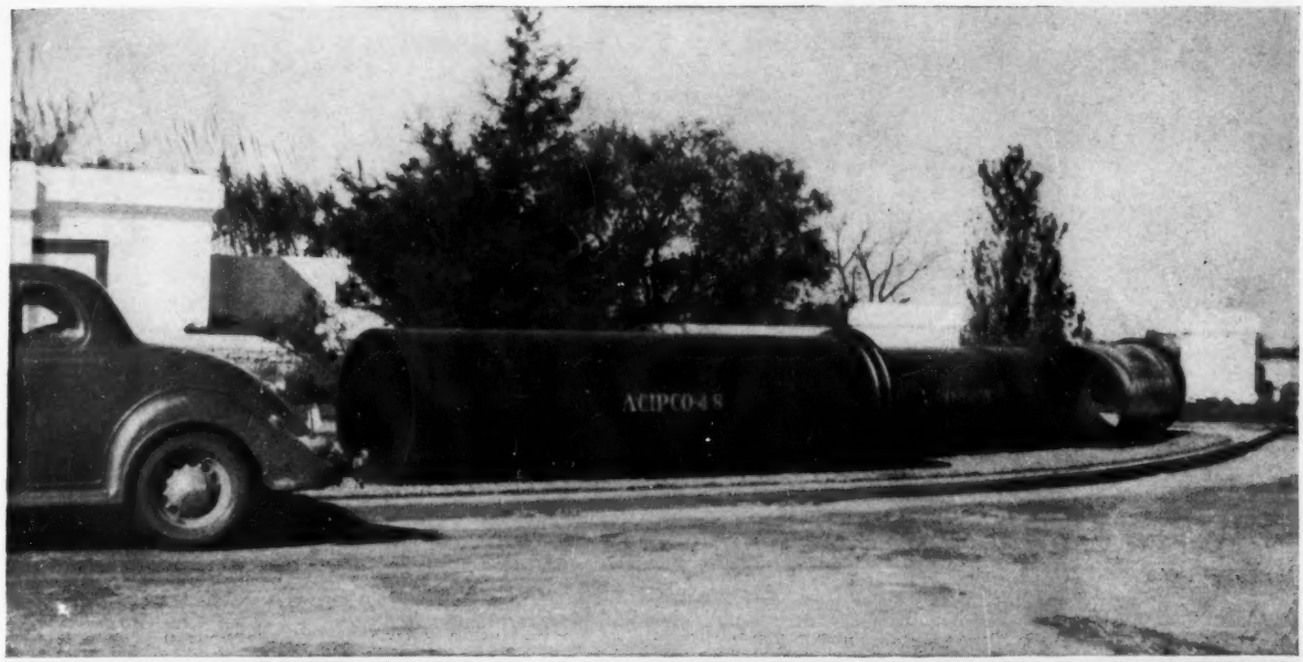
REX SANITATION EQUIPMENT

CHAIN BELT COMPANY OF MILWAUKEE

Baldwin-Duckworth Chain Belt Division, Springfield, Massachusetts • Worcester, Massachusetts
Rex Chain Belt and Conveyor Divisions, Milwaukee, Wisconsin

50TH ANNIVERSARY 1891 REX 1941 CHAIN BELT COMPANY

MODERN PIPE *for* *Modern Service Requirements*



MONO-CAST *Centrifugal* PIPE

DIAMETERS 3" to 48" INCLUSIVE. FURNISHED *Enamelined* AT NO EXTRA COST

TIME has proved the enduring qualities of Cast Iron Pipe. But times have changed, are still swiftly changing. Today's and tomorrow's underground mains must do much more than merely resist corrosion. They must convey greater volumes, at higher internal pressures; they must withstand vastly increased external loadings; they must be adapted to an ever-widening range of service conditions. Mono-Cast Centrifugal Pipe possess the exceptional physical strength and uniformity necessary to meet the increasingly severe requirements of modern usage. That's why they are held in such high esteem by municipal officials, engineers, superintendents, industrialists and others in a position to know. In the future, as in the past, Mono-Cast Centrifugal Pipe will continue to serve most dependably at least cost per service year. Write for literature.

AMERICAN CAST IRON PIPE CO.

America's largest individual Cast Iron Pipe foundry. Daily foundry capacity 40,000 feet in all sizes from 3" to 48" inclusive. Complete line of highest quality Cast Iron Fittings.

FOUNDRY AND MAIN OFFICE, BIRMINGHAM, ALABAMA. BRANCH OFFICES: NEW YORK CITY, CHICAGO, MINNEAPOLIS, KANSAS CITY, DALLAS, SAN FRANCISCO, LOS ANGELES, PITTSBURGH, CLEVELAND

You'll have SURE CONTROL of WATER MAINS

— with CRANE No. 480½ A. W. W. A. Gate Valves

Oval body and bonnet design of heavy cast iron sections affords high resistance to line stresses. Two piece gland construction prevents binding of stem. Sturdy, simple disc spreading and unwedging mechanism prevents jamming; aids positive closure without drag on seating faces. Conform fully to latest A.W.W.A. specifications.

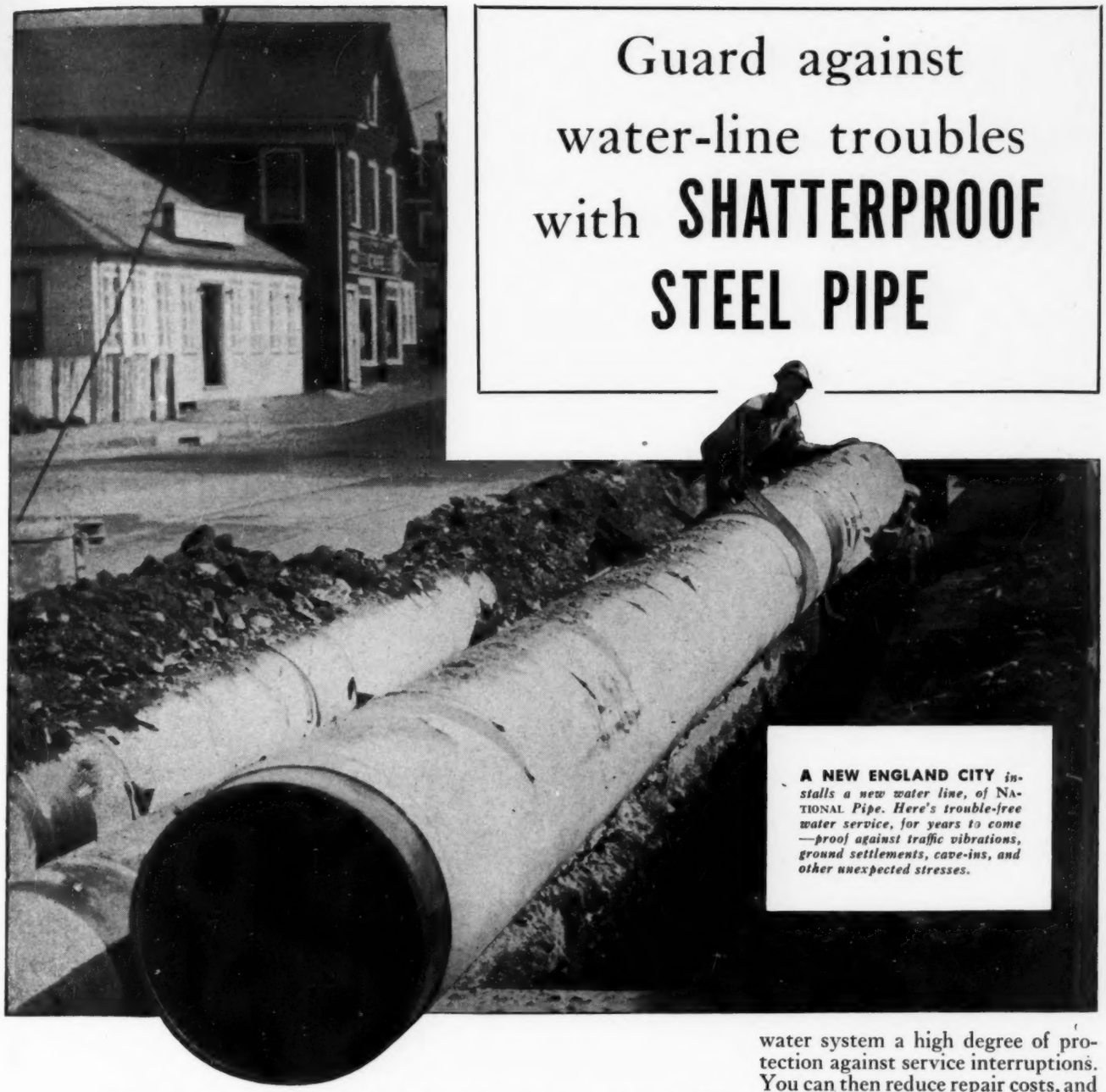
For every water and sewerage works service, the right valves and fittings are available in the Crane line of over 38,000 piping products. There's a well-stocked Crane Factory Branch or Wholesaler nearby—ready to fill your order.

CRANE

VALVES • FITTINGS
PIPE • PLUMBING
HEATING • PUMPS

CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVE., CHICAGO, ILL.

Guard against water-line troubles with SHATTERPROOF STEEL PIPE



A NEW ENGLAND CITY *installs a new water line, of* NATIONAL *Pipe. Here's trouble-free water service, for years to come —proof against traffic vibrations, ground settlements, cave-ins, and other unexpected stresses.*

. . . your best protection against the "unexpected"

YOU can't always predict where or when the next washout will occur; where the ground may settle; or where street traffic or nearby construction may set up destructive vibrations. Yet these and other types of unpredictable stresses can cause serious ruptures in water lines — *unless* they are constructed of shatterproof material.

NATIONAL Steel Pipe is shatterproof pipe. It has amazing strength and resilience; you can bend it, twist it, and even flatten it, but unlike frangible materials, it will not break suddenly, or shatter. This property makes steel pipe the ideal material for mains, service lines, and laterals. By using steel for all new lines, and for replacements, you can give your water system a high degree of protection against service interruptions. You can then reduce repair costs, and save property damages.

In addition you save installation costs with NATIONAL Steel Pipe, because it comes in long lengths, requiring fewer joints, less labor, less joint material. These are only a few of the reasons why hundreds of American Cities are now using steel pipe in their water systems. Be sure and specify NATIONAL Steel Pipe for mains, service lines, and laterals. Write today for complete data.

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York

UNITED STATES STEEL

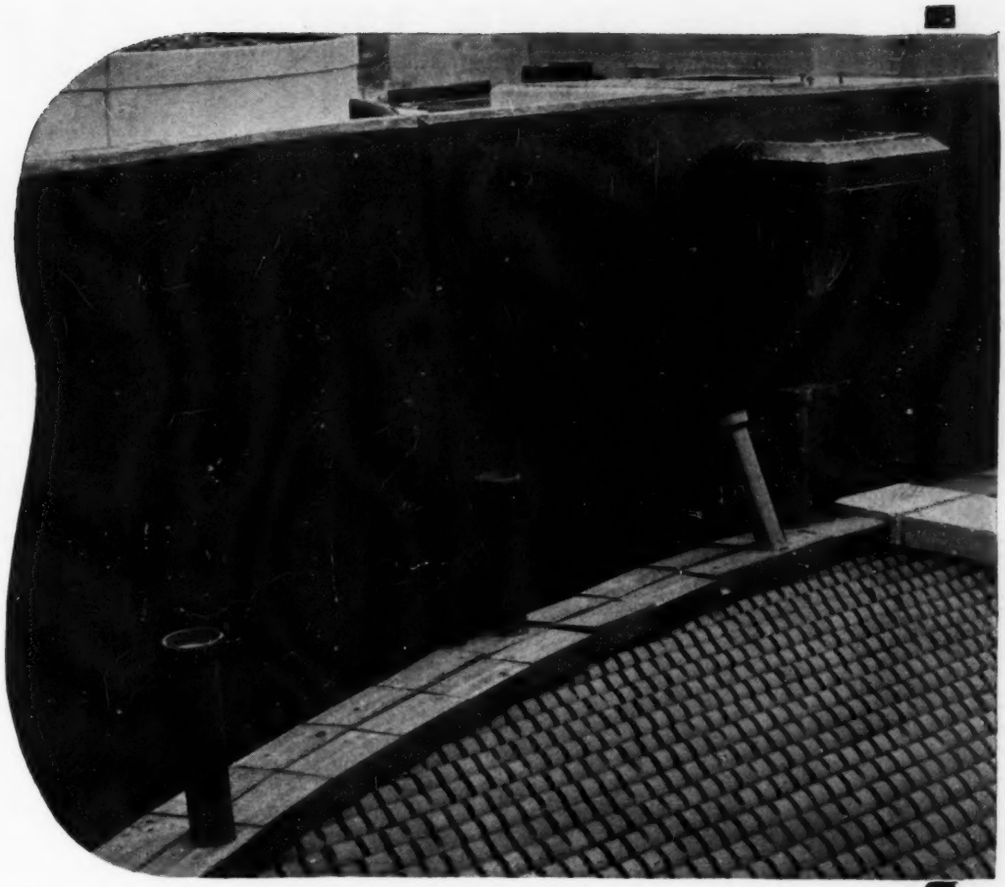
DIAMOND
FERRIC CHLORIDE
Exclusively

Leading sewage engineers have found in the new DIAMOND FERRIC CHLORIDE the ideal material for sewage coagulation and sludge conditioning. Steps up the removal of settleable and suspended solids, thereby increasing plant capacity and efficiency.

DIAMOND FERRIC CHLORIDE is available in 60% crystals packed in 300 and 500 lb. barrels, and in tank cars of 38-45% solution. Try Diamond Brand on your next order.

DIAMOND ALKALI COMPANY

Pittsburgh, Pa., and Everywhere



Bitumastic No. 50 on one of concrete tanks—Kutztown Sewage Disposal Plant, Kutztown, Pa. William A. Goff, Philadelphia, Pa., Consulting Engineer. Thomas Proctor Company, Long Branch, N. J., Contractor.

BITUMASTIC No. 50

guards Kutztown Plant from corrosion

Planned economy in operating and maintenance costs was the keynote of the design of the recently built system of Sanitary Sewers for the Borough of Kutztown, Pa., erected at a cost of $350,000.00.

In order to insure steel and concrete surfaces against corrosion and deterioration, Bitumastic No. 50 was selected to coat the interior of sludge conditioning and digestion tanks, primary and final settling tanks, interior of the pump section well, dosing tank, walls of the sludge drying bed, all channels, trickling filter beds and exterior walls of the Control Building from the finished grade down to the foundations.

Bitumastic No. 50, developed from a background of over 80 years in dealing with the most severe corrosion problems under ground and under water, is a unique coal tar base black coating, applied cold to an unusually heavy film. Multiple coats may be applied up to 1/16 of an inch on vertical surfaces without appreciable running or sagging. Bitumastic No. 50 is not an emulsion and contains no asphalt. It withstands atmospheric temperature of from 140° F. to minus 10° F.

This unusual coating has had a quick acceptance from engineers, contractors and sewage executives in protecting all kinds of metal and concrete surfaces in contact with severe moisture, sewage and fumes.

Write for folder on Bitumastic No. 50 containing detailed specifications.

ALSO A COMPLETE LINE OF INDUSTRIAL MAINTENANCE PAINTS★

WAILES DOVE—HERMISTON CORPORATION

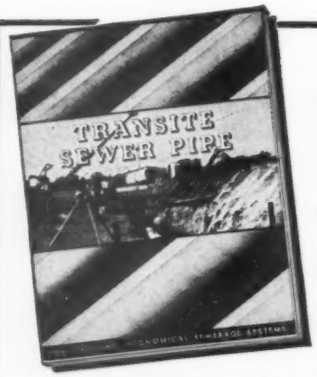
WESTFIELD, NEW JERSEY

NEW YORK - PHILADELPHIA - CLEVELAND - CHICAGO - HOUSTON - TULSA - SAN FRANCISCO - LOS ANGELES - MIAMI

A 5-POINT SAVING IN SEWER-LINE COSTS

TRANSITE'S LONG LENGTHS facilitate laying pipe to accurate grades, speed up installation and reduce the number of joints in the line.

1. SHALLOWER TRENCHES
2. SMALLER PIPE
3. FEWER JOINTS
4. LESS INFILTRATION
5. LOWER MAINTENANCE COSTS



WRITE FOR YOUR FREE COPY OF THIS NEW BROCHURE

LOOKING for lasting sewer-line savings? Check the advantages of J-M Transite—the asbestos-cement sewer pipe. You'll see how this modern material provides important savings on all the above points.

In municipal sewer systems, Transite's high flow coefficient, tight joints, corrosion resistance and uniform strength are establishing a new standard for efficient, economical service.

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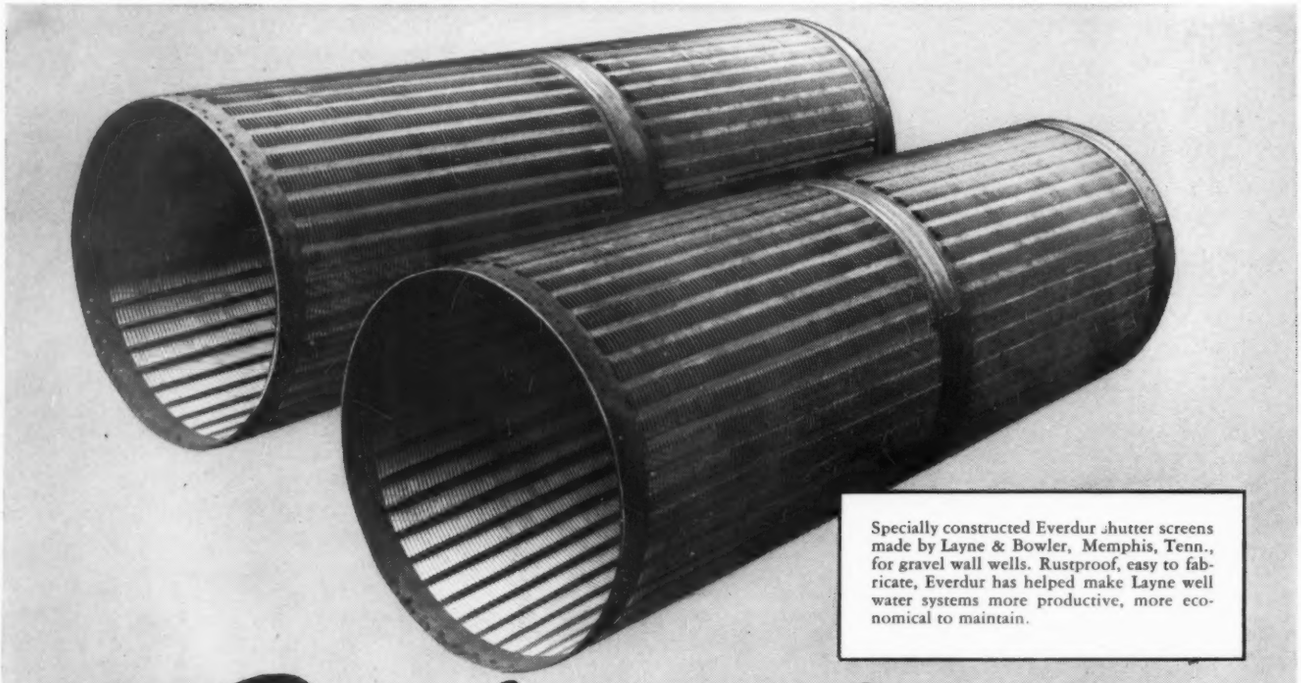

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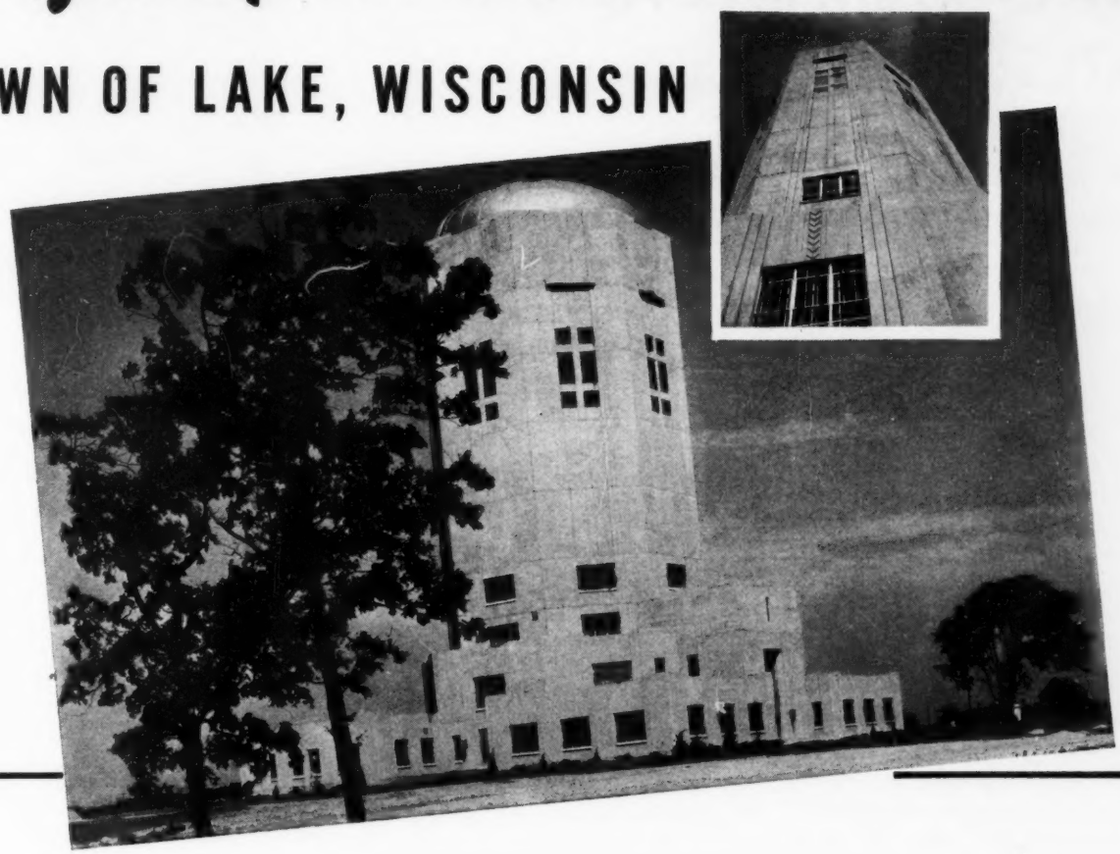

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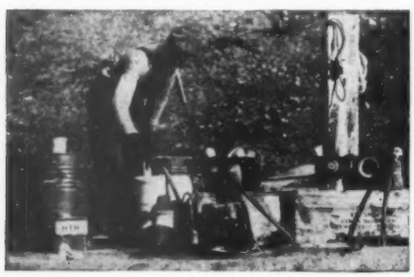

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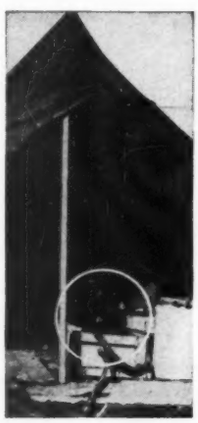

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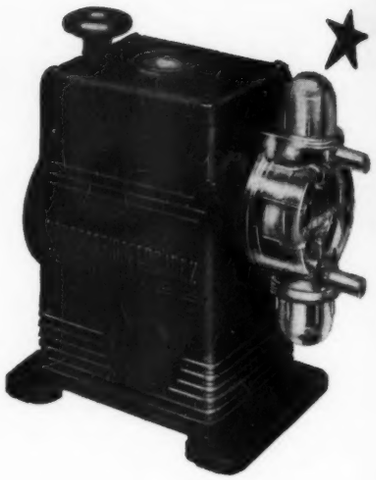

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WATER WORKS & SEWERAGE

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EDITORIAL OFFICE
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COMING!

"Waste Disposal Problems of the Petroleum Industry"

Relates the nature and complexity of the problem of purifying and disposing of the heterogeneous wastes from petroleum production and its refining—a problem of increasing magnitude and interest nationally. Planned to run in this issue, but unavoidably delayed, this article will appear in April. It will constitute the second of a series of articles which will deal with methods of treatment and disposal developed during their years of endeavor by an important unit of the industry itself. The company in question is commended for its willingness to release this accumulation of valuable information through the series of articles arranged for. The authors—
W. B. HART, Director of Wastes Disposal,
R. F. WESTON, Sanitary Engineer,
The Atlantic Refining Co., Philadelphia.

"Some Practical Aspects of Porous Plate Filter Bottoms"

Is something of a real boost for filter bottoms of porous plates, which eliminate the trouble making lateral orifices and gravel beds. The writer speaks from experience "before and after" converting an orthodox filter to a porous bottom unit and, thereafter, observing the performance and conditions of the old and the new side by side for better than a year and six months. The article reveals information of a practical nature concerning rates of cloggage of the porous plates and head recovery after an inexpensive cleaning operation. As the result of observations, performance and proof of ready cleanability of plates, the plant is now being completely equipped with porous bottoms. The "Why" is told by—
HENRY T. HOTCHKISS, Supervising Chemist, Dep't of Water and Sewerage, Larchmont, N. Y.

"Rutherford's New Treatment Works"

Is a description of a plant of unusually flexible design and modern in every quarter. This plant, with control features of unusual interest, was designed for highly variable industrial and domestic loadings, permitted by a selection of combinations of chemical pretreatment and high or low rate trickling filters, final mechanical filtration, and incineration of sludge. The article stresses the unusual and most interesting features of design and operation. The author—
ALBERT B. KOZMA,
Sup't of Treatment Works,
Rutherford, N. J.

"An Adjucator of Many Water Works Problems"

Is the sub-caption of an article which should sell many a flow recording "Meter-Master." This story is the most replete of any ever written, in disclosing the variety of applications of this information revealing water works instrument. What its revelations have meant in dollars and cents to a Water Department, as the result of more correct metering, compound meter shunting, checking pump efficiency, etc., is told by—
D. R. TAYLOR, Plant Superintendent,
Roanoke, Va.

"Water Hammer Corrections"

Is an article which discusses methods and equipment available on the market for most successfully correcting the disturbing and destructive pipe line surge or water-hammer. Included is a highly useful section devoted to shock absorbing devices found effective as water hammer suppressors for small pipe lines and consumers piping systems. The author—
RICHARD BENNETT, Hydraulic Engineer,
City Engineer's Office, Phoenix, Ariz.

"Surveying for Water Waste"

Is an article which outlines methods, plan and procedures in conducting modern water waste surveys. This contribution has been prepared at our request in order to bring up-to-date what has developed in the way of procedure most effective in tracking down costly water losses through leaking distribution systems. It will be run as an article and thereafter reprinted in our forthcoming Reference and Data Number for 1941, to replace an older article on this topic. The author—
EDGAR K. WILSON, Chief Engineer,
The Pitometer Co., New York, N. Y.

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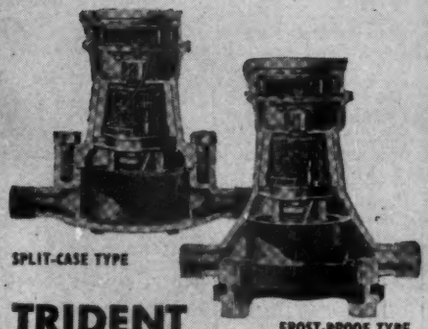

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WATER WORKS & SEWERAGE

VOL. 88, NO. 3 *A Gillette Publication* MARCH, 1941

"ABBREVIATED CONCRETE"

Saves Several Thousand Dollars for Roanoke, Va.

By D. R. TAYLOR
Plant Superintendent, Water Department
ROANOKE, VIRGINIA

GUSHING forth boldly at the base of Mill Mountain, which rises abruptly almost a thousand feet, is Roanoke's famed Crystal Spring, the present major constituent of the water supply of this thriving little city in Southwest Virginia. However, as remarkable as is this large spring, progressive developments are now being made for a much larger source of supply, the need for which is soon to become urgent.

The Author

Formerly a source of power for an ancient water-driven wheat and grist mill, Crystal Spring produces daily five million gallons of pure, palatable, crystal-clear and sparkling water. In prior years the Machine Shop Band of the Norfolk & Western Railway gave Sunday concerts from a bandstand constructed over a lake below the spring. And, legend has it that during the gay nineties an intrepid young male trapeze artist climbed high into the air one moonlit night, suspended himself by his teeth to a pulley on a wire, ignited his gasoline soaked tights, precipitated himself some three hundred feet at a "terrific" rate, and dropped off into the lake, much to the amazement and exultation of the hundreds of charming, pulchritudinous, corseted and bustled southern belles and their beaux, who had gathered to witness the amazing and incredulous display of daredevil bravery.

Photo No. 1—The Crystal Spring and Reservoir

Those days have passed. Corsets (if any) are now replaced by foundation garments, and the lake was replaced some thirty-five years ago with a concrete basin into which the spring flows and from which water is pumped to a distribution reservoir located nearby on the side of Mill Mountain.

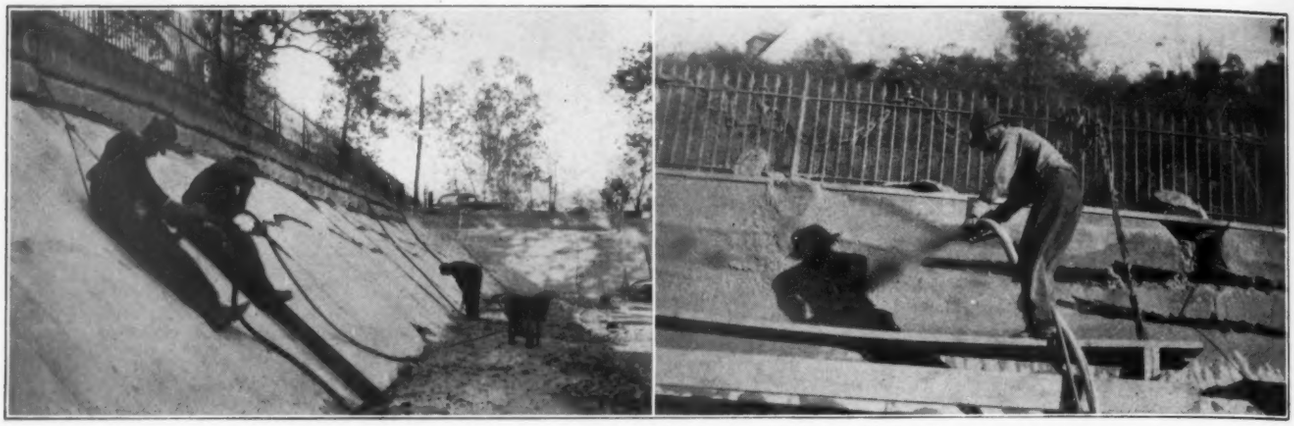
The Crystal Spring Basin

This basin was constructed in a combination excavation and a fill on marshy ground, with side walls sloping up from its bottom at an angle of about forty-five degrees to a parapet wall eighteen inches wide, thirty-three inches high on the inside, and six inches above ground level on the outside. On top of this wall is an ornamental iron fence three feet high.

This basin is approximately two hundred and ninety-one feet long and one hundred and sixty feet wide inside the parapet walls, with side walls sloping from eleven to sixteen feet from the base of the wall to the bottom of the basin, the floor also sloping.

Due to the marshy condition of the ground on which this structure is located, it was necessary to install a fan-shaped network of drains of unjointed tile underneath the floor. These drains all empty at a common point at the north end of the structure. The walls have asphalt expansion joints running vertically and spaced ten feet apart. The floor is gridironed with such joints, forming squares with ten-foot sides.

The accompanying photograph (No. 1) was taken just above the spring, looking north. On the lower right side can be seen the wire mesh screen over the spring and extending over the concrete channel, which conveys the water to the basin seen in the distance. The pump



Photos No. 2 and No. 3—(Left) Chippers at Work on Side Wall Cracks. (Right) Nozzle-man Filling Cleaned-out Cracks.

station can be seen in the upper left corner. As can be seen, the grounds are beautifully developed with trees, shrubs and flowers, and it can be well imagined that this is still an historic spot to Roanoke's older citizens, an object of civic pride, and a rendezvous to which out-of-town guests are brought.

Disturbing Leakage Develops

A good many years ago, it was learned with some misgiving, during a minor repair job, that no reinforcing steel was used in the construction of this basin. After that discovery, a careful watch was kept on the amount of water emerging from the drainage system under the basin to detect any increase in flow from year to year that might indicate leakage through the bottom or sidewalls.

Photo No. 4—A Bad Corner Before Repairing. (Compare with finished job in Photo No. 7.)

In 1934 it was believed that the flow was increasing; consequently a "V" notch weir was immediately installed and readings taken daily. Within several months it was definitely proven that there was an increase in flow in spite of the fact that no abnormal precipitation had occurred during the time that the readings were being taken.

Shortly after this determination, the time for a regular semi-annual cleaning arrived, during which a very careful examination was made of every square foot of the concrete. It was discovered that a portion of the parapet wall in the northeast corner was breaking away from the sloping side wall, and it was concluded, and logically so, that a small leak through a crack where this wall joined the top of the sloping side had softened the earth embankment supporting the wall and allowed this wall to break away at the fulcrum point.

It was also discovered that there was leakage in varying amounts under old patches made with every possible kind of material that several ingenious predecessors could purchase, invent, or concoct. There were also some seventeen hundred linear feet of small cracks, most of which would hardly admit a thin knife blade. The concrete at these cracks was slightly disintegrated, and the presence of silt, drawn to these cracks, indicated leakage, and the quantity and size of the silt was indicative of the amount or rate of leakage.

Seeking a Practical Economical Remedy

The question, what to do, had now reached a point of real moment, and the fact that this basin constitutes an important factor during a major conflagration rendered the solution of the problem the more imperative.

It was finally decided that inasmuch as the small portion of the broken parapet wall was the principal issue, a trial would be made of the gunite-method of repair. After some shopping around, a contract was made to install a gunite coat, consisting of one part cement and three and one-half parts sand, two inches thick, over the damaged portion of the corner in question. The gunite was reinforced with two-inch by two-inch, twelve gauge wire mesh set parallel to and one inch out from the surface of the old concrete (to center in the gunite coat) and firmly anchored with expansion bolts, placed on two-foot centers vertically and horizontally. This much was done in April, 1935, and has proven very successful and satisfactory.

At the time of the first repair, the contractor was asked about repairing the cracks also. He informed us that the only satisfactory way to repair them was to cover the entire basin solid with gunite, just as the corner had been repaired. Such a job would have cost $20,000 or more. This method was out of question,

because, even if the cost was not considered, keeping the basin empty as long as would be required was too much of a chance to take. We inquired about just guniting the cracks, but were told that, while it was not the best practice, it could be done by chipping out the cracks in the shape of a dovetail and reinforcing them with wire mesh.

What "Couldn't Be Done"—Was Done

We countered with a suggestion to chip out the cracks "V" shape and to shoot them without reinforcing wire. We were told firmly and parentally that this method was entirely unsuccessful. We inquired of other contractors about the suggested method, and they were all prophets of doom. None of them would subscribe to our beliefs. Those who were not sure shook their heads in a "doubting Thomas" manner. The more we were admonished, the more resolute we became. No one could cite actual cases. It just seemed that it was the kind of thing that was "not being done." Finally we broke through the crust. Some had tried hand-placed cement in such a manner, and it came out; therefore, they were assuming that gunite would do likewise.

Then we made a decision. While the contractor was set up, we persuaded him to gunite one hundred linear feet of cracks in accordance with our suggested method —"for experimental purposes" only. We reasoned that the cost was small (even if it failed), and the possible savings, if it was successful, were immense.

The Scheme Seemed a Success

The major portion of the leakage having been stopped by the original repair of the damaged wall, we felt that we had more time to examine and study the results of the experiment. We termed it the "abbreviated method." Consequently, we carefully examined the "hundred feet" during each semi-annual cleaning period for a span of two years. At the end of this time, the absence of any disintegration, cracking, leaching (or leaking) was sufficient evidence to substantiate our verdict for the defendant.

As the result, a contract was awarded on competitive bids to the original contractor, on an hourly basis, to furnish the gunite machine and six pneumatic chipping hammers with hose, and we furnished the air, water, materials, labor, and supervision. This work was done in October, 1937.

"The Abbreviated Method"

Photograph No. 2 shows two chippers at work on the west side wall and one of several men following closely behind cleaning up the "mess." Like filling a tooth, it was, of course, necessary to remove all of the decayed matter before the "filling" could be installed. In doing this, the resultant "V" shape cavities were from three to twelve inches wide at the surface of the original concrete and two to eight inches deep.

Photo No. 5—Guite Machine and Mortar Box.

Photograph No. 3 shows the nozzle-man following and shooting.

Photograph No. 4 shows the bad southeast corner ready to be "shot," and photograph No. 5, the gunite machine in action and mortar box.

At several places where the side walls joined the bottom, continuous small streams of ground water ran into the basin, increasing as the old concrete was chipped out. From the entrance of each of these "rivulets", we excavated a small trench with a slight declivity to a point where the water would empty on top of the floor, where we had installed a two-inch weep pipe. We then covered each of these small trenches with roofing tin and gunited over top of it, leaving only the weep pipes protruding, allowing the water to continue to drain.

That portion requiring weep pipes was done first, so the cement would have sufficient time to set by the time the whole job was completed, thus allowing the pipes to be plugged before the basin was refilled.

In photograph No. 6 is shown the southeast corner completed. The condition of this corner before shooting is shown in photograph No. 4.

Photograph No. 7 shows the completed portion of the east wall that is shown being shot in photograph

Photos No. 6 and No. 7—(Left) One of the Worst Corners Completed (Compare with Photo No. 4 before repairing). (Right) Same Side Wall as Pictured in Photos 2 and 3. (Location of one of the weep pipes indicated by arrow.)

Photo No. 8—The Completed Job Being Washed Up After Six Days from Starting.

No. 3. The arrow points to the location of a weep pipe which has been plugged.

All of the old asphalt in the expansion joints of the floor was removed, after which they were repoured with fresh asphalt.

In photograph No. 8 the entire surface is being washed with a fire hose preparatory to turning in the water from the spring.

During this more recent repair job, some portion of every linear foot of the entire perimeter (other than the southeast corner) and some of the floor was gunited.

Job Completed in Less Than Week at $1,500 Cost

The job was started one morning at seven o'clock and required six and one-half days, during one of which it rained. Although this hampered and prolonged the job, it did not cause complete suspension during that day. The chippers worked in shifts from fourteen to twenty-four hours per day for four days. Concrete was shot a total of thirty-eight and one-half hours in four days. No shooting could be done during the day of rain. When the job, which of necessity was pushed to the limit under some tension, was completed, those who had been on the job an average of fifteen hours per day were glad to retire with a feeling of "finis coronat opus."

A total of approximately sixteen hundred linear feet of cracks were repaired at a total cost of $1,500, and it is believed that at least $18,000 was saved by the method used.

After more than three years of weathering, the gunite is in perfect condition; the drain indicates no leakage; our corporate wallet is not as thin as it could have been; our theorem has become an axiom; and our belief in the adaptability of gunite has been further "cemented."

"Blacking-Out" Algae

(Addenda Statement to the Author's Article in Water Works and Sewerage, August, 1940)

By WM. T. BAILEY
Chemist, City Water Works
COUNCIL BLUFFS, IOWA

On emptying the two primary coagulation basins for washing early in October, 1940, they were found to be virtually free from algae. Carbon treatment was discontinued at this time, as has been our custom in the past few years. However, as the result of low river stage, low tubidities, and unusally warm, sunshiny weather, free floating forms of algae immediately developed in sufficient proportions to produce considerable taste in the chlorinated water. Copper sulphate was applied immediately and the "Black-Out" treatment* was resumed. This corrected the taste, and no further difficulty was experienced.

Comparing Carbons

The appearance of this growth so late in the fall leads us to believe that our comparison of algae inhibiting power of two activated carbons reported on may have been erroneous and premature, inasmuch as no record was kept of the intensity of sunlight, nor the number of days of clear and cloudy weather in the two years this treatment was used. It would only seem logical that those factors affecting the growth of algae should have an important bearing on the dosage required for inhibiting growths in various seasons and years. And it would also seem that the carbon possessing the greatest dispersion and spreading power should intercept the greatest portion of the sun's rays; and that having the greatest suspendibility should remain at, or near, the surface for the longest period of time and thus give the inhibiting effect over the greatest basin area.

Of Value in Small Plants

Inhibiting algal growths in coagulation and settling basins adds another to the list of uses for which activated carbon has heretofore been applied, namely, removal of organic taste and odor producing substances, sludge stabilization, dechlorination, and the removal of algae from open clear water reservoirs. It may be particularly advantageous in the small plant, as it can be applied by mixing a small amount with water and pouring the resulting slurry along the walls of small basins; one or two applications daily being all that may be required. An over dose may have no harmful results unless a sufficient quantity of carbon is carried on filters to appreciably shorten filter runs. And, with the various carbons that are available, the operator should have litle difficulty selecting one to suit his needs.

[*The "Black-Out" consisted of floating on the basins a thin film of powdered carbon. This black suspension, and top film, in blanketing out the light, prevented algae from growing in the basins, particularly on the side walls. —Ed.]

MADISON'S NEW "WATERSPHERE"

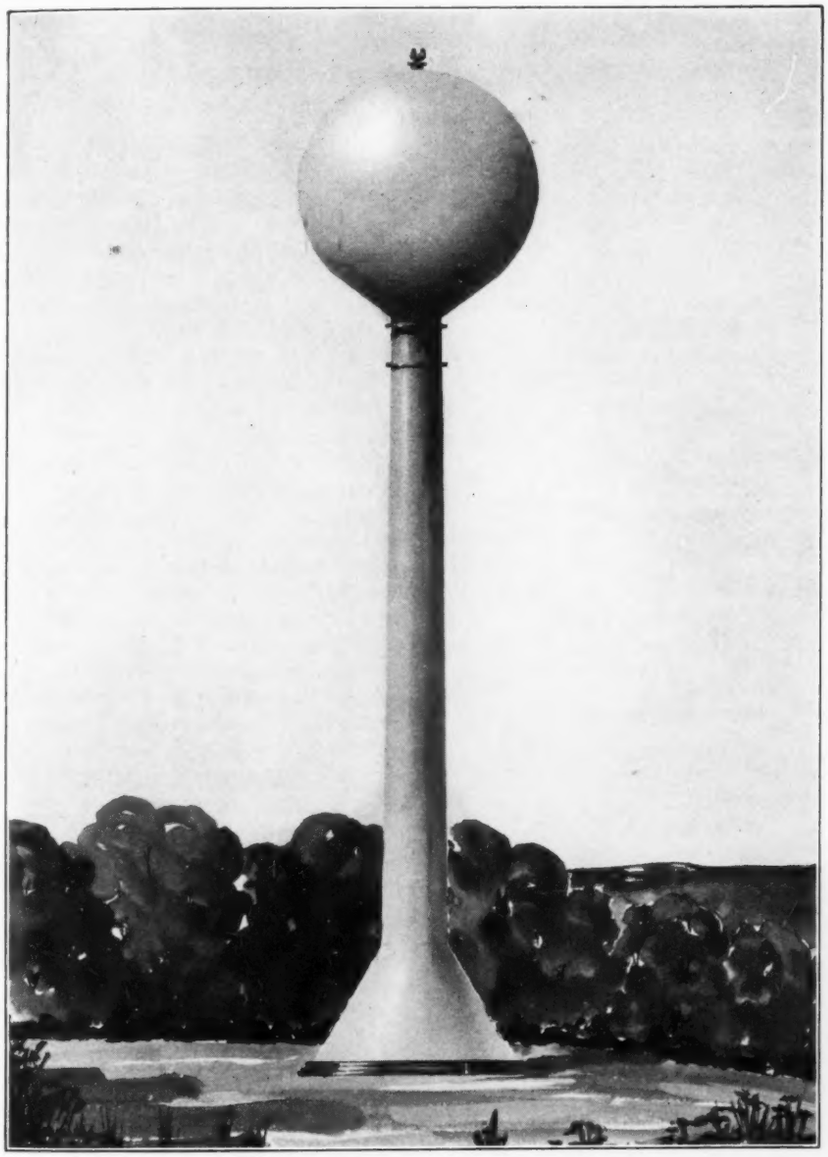
Provides Elevated Storage of 100,000 Gallons on a Column 100 Feet High

By L. A. SMITH
Superintendent, Water Department
MADISON, WISCONSIN

THE city of Madison, Wisconsin, has recently awarded a contract for a 100,000 gallon "Watersphere," 100 feet high.

The unique watersphere is a modern version of the elevated tank. It consists of a truncated cone base, which is 26 feet in diameter at the bottom, tapering to an 8 foot diameter at the top, and is approximately 16 feet high. This base cone supports a riser column 80 feet high, having a base diameter of 8 feet which tapers pleasingly to a diameter of 6 feet at the top. On this column rests the 30 foot diameter watersphere. The thickness of the steel plate employed varies from ½ inch to ¾ inch, with the exception of the upper half of the sphere, which is fabricated of ¼ inch steel plate. The accompanying artist's sketch pictures Madison's new Watersphere as it will look when completed. (See also cover illustration in color.—Ed.) This tank is designed to serve an area in the western partion of the city which is too high to be served satisfactorily from a 6 million gallon high service reservoir which floats on our distribution system. The cost of the entire improvement, including land, Watersphere and 1,000 feet of 10 inch C.I. main connecting it to the distribution system, will be approximately $20,000.

The Author



Madison's "Watersphere"

This 100,000 Gallon Sphere and Column, Designed to Withstand a 100 m.p.h. Wind, Will Contain Roughly 55 Tons of Steel. With a Particular Desire to Secure the Most Eye-Pleasing Effects, Especial Attention Has Been Given to the Selection of Coloring for the Paint Job.

(Our cover illustration on this issue represents an attempt at reproducing the color effects developed by the artist making this sketch.—Ed.)

The city of Madison obtains its water supply from eleven deep wells, four of which are located in a group near a steam pumping station and the other seven at various points in the distribution system. These seven wells are known as unit wells and are self-contained pumping stations, including surface reservoirs and electrically driven pumps, pumping directly into the distribution system.

Madison is located on an isthmus between two lakes, the normal elevation of the water in the upper lake being approximately 865.4 U.S.G.S. datum. The eastern portion of the city, with the exception of a comparatively small area near the lake shore, is rather low varying, from an elevation of 875 feet to 900 feet. On the other hand, the western portion of the city, in which the University of Wisconsin is located, is rather hilly, being dotted with several terminal moraines laid down retreating glaciers. In fact, Bascom Hall, which is the main hall at the University, and the Astronomical Observatory of the University, are both located on such moraines.

Up to about fifteen years ago, the Water Department operated under a direct pressure system—i.e., the wells were pumped direct into the mains on which pressures fluctuated

widely with water use. This was unsatisfactory for five reasons. (1) Pumping capacity had to be provided to meet maximum demands. (2) There were large fluctuations in pressure due to momentary peak loads. (3) Excessive water hammer conditions resulted from such closed system operation. (4) Electrically operated unit wells did not operate at the best point of efficiency. (5) The load factor on the plant was very poor.

Reservoir Improved Operating Conditions

To remedy the conditions above outlined, a reinforced concrete reservoir of 6 M.G. capacity was built in 1926 on a site which had an elevation of 1,056 feet, providing a maximum water level of 1,050 feet. This reservoir maintains adequate pressure to all parts of the city, with the exception of a comparatively small area which has an elevation between 960 feet and 1,000 feet. Originally, there were only twenty to thirty houses in this area, and a small electrically operated booster pump was installed to provide adequate service pressures. At the present time there are in excess of three hundred homes in this area and during the interim period additional booster pumps have had to be installed. There are now two automatically operated booster pumps, one having a capacity of 325 gallons per minute and the other 500 gallons per minute. The controls are so arranged that either one or both of the pumps can be put in service if necessary. This means that there exists now the same situation in this area that formerly existed in the entire city; that is, there are large fluctuations in pressure and the pressure is either too great or insufficient. Because of the satisfactory operation and adequate consumer's service in the balance of the city, due to the six million gallon reservoir, it was deemed advisable to serve this area with an elevated tank. And a site was selected with an elevation of 1,015 feet.

Elevated Tank Contracted For

A contract has been let to erect a 100,000 gallon elevated tank on this site, in which the entire 100,000 gallons are stored at an elevation of 1,115 feet—i.e., 100 feet above ground level. This will provide a minimum pressure of approximately 50 pounds per square inch in this entire area, which is sufficient for adequate domestic service. In this locality there is a 10 inch pipe line encircling the district and the elevated tank will be connected to this pipe line with a new 10 inch pipe line 1,000 feet in length. The tank will have three advantages over the present method of operation. (1) It will assure a uniform pressure being maintained. (2) It will provide a reserve for fire protection. (3) It will increase the efficiency of pumping because the pumps will always operate at the highest point of the efficiency curve.

Usual Contention Over Location

The people living at the higher elevations were in favor of elevated storage but wanted the tank at some other location than near their homes. I think that this is a typical reaction and one that might be expected, under the circumstances. In such a case, the fair method of procedure is to select a location which would give the pressure required at the minimum cost. The location selected was at the opposite end of the district from the location of the booster pumps. The pipe line connection to connect the pipe line to the distribution system was only 1,000 feet in length so that the entire improvement could be made, including the site, pipe line, Watersphere, as well as engineering and contingent expenses, for the amount heretofore stated, approximately $20,000.

Obviously, the higher the elevation which can be found, the lower the cost of the elevated tank; and the shorter the pipe line that must be installed, the lower the cost of the entire project. The problem, then, is rather simple and the location selected was one which provided a reasonable elevation for the tank, as well as being fairly close to the 10 inch loop.

Why the Watersphere?

In advertising for bids for the elevated tank, we notified the contractors that it was to be located in a residential district and, in consequence, that an ornamental type of tank was desired. The Watersphere selected will cost approximately 6 per cent more than the best designed conventional tank, but was selected for three reasons. (1) It was considered to be a unique departure in tank design, something new to the public eye, and more pleasing in appearance. (2) From a practical point the cost of maintenance is to be less, because less handwork in painting will be necessary. (3) There are no legs to support the tank, so that youngsters playing in the neighborhood cannot climb up the tank, with the chance of falling off.

The Board of Public Works and the Common Council were at first sight concerned with the stability of the structure and, in consequence, a design was chosen which will be safe, with a wind velocity of 100 miles an hour.

Giving considerbale thought to appearance, it is proposed to paint the Watersphere in a carefully chosen combination green-gray-blue color, designed to provide harmonizing tints to blend in with the background of trees and also the sky. It was considered undesirable to paint the name "City of Madison" on the side of the sphere, as it seemed to us this would detract from its appearance, which is intended to be artistic in effect. The only lettering on the tank will be that on the top, where an airport directing arrow will be located.

Appurtenances Include Cathodic Protection

The tank will be equipped with all modern devices, including automatic aeronautical lights, as requested by the Civil Aeronautics Authority; a cathodic rust prevention unit, to protect the inside of the tank from corrosion; and, an automatic cone valve to control the heighth of water in the tank. Incidentally, this automatic cone valve will be located in the base of the tower, thus saving the cost of a special pit which would otherwise have to be built.

[Note: This rather brief description of Madison's latest improvement in domestic and fire service is to be supported with a more detailed description of the new tank and appurtenances, together with reactions of the public and operating experiences after the unit is in service.]

WATER RATE INCREASE BRINGS ON MINE STRIKE

In the towns of Royal and Allison, Penna. a flat charge water rate increase was allowed by the Public Utility Commission. Because of the flat rate increase from $1.50 monthly to $2.25, further complaints were heard leading up to the four day "holiday" taken by 6,700 coal miners in protest against the 75 cents per month increase, termed "outrageous" by the Citizens Committee.

It must be admitted that, when considered on a percentage basis, a 50% increase at one clip does sound rather portentous. However, this new rate was granted by the Commission after strenuous objection was made by the Citizens Committee to installation of meters as proposed by the Allison-Royal Water Co.

A DIGESTER CORROSION PROBLEM

Involving Studies Leading to Application of the Cathodic Method of Subduing Internal Galvanic Effects Identified as Responsible

By G. A. PARKES
Assistant Engineer,*
Department of Public Works
LOS ANGELES, CALIFORNIA

THE classic words of the farmer who, seeing a giraffe for the first time, exclaimed, "There ain't no such animal," came promptly to the mind of an engineer who stood in the empty digester at the Terminal Island Sewage Treatment Plant of Los Angeles one day in December of 1937, and surveyed the condition of metal parts within the structure. Such corrosion and pitting was simply unknown in digesters at that time.

In the fourteen months' time that the plant had been in operation corrosion had attacked almost every metal part which had been in contact with the sludge and supernatant liquor. Pitting had penetrated to a depth of five-sixteenths of an inch in a few places, while in many places extensive areas showed corrosion varying from one thirty-second to one-eighth of an inch below the original surface.

Certain peculiarities were noticed. One side of a structural member might be severely corroded while the other side of the same member remained entirely untouched. The hot water coils of galvanized wrought iron were badly attacked in some places and in others the original galvanizing was intact. The hooks supporting the coils were likewise affected.

No one part of the tank was affected more than another and all metal parts in the tank were affected. It so happened that all these parts were of iron or steel and no brass, aluminum or other non-ferrous metals were present. Interestingly, the galvanized wrought iron pipe had been attacked as badly as the structural steel of the sludge stirring mechanism.

The digester in question is a single stage, fixed cover, heated, concrete tank, 75 feet in diameter by 27 feet sidewall height. It is the only digester in the plant, which receives the entire sewage of the Harbor District of the city of Los Angeles, California. This comprises the San Pedro, Wilmington and Terminal Island areas in which there is a total population of about 60,000 persons.

*Engineer in Charge of Plant Operations.

The sewage treated at the plant averages about 3.0 million gallons daily and includes a considerable industrial load from two fish canneries in Wilmington. The industrial load fluctuates very widely, sometimes amounting to a population equivalent of three times the domestic load. Solids and oil in the cannery waste caused a thick tenacious scum to form in the digester.

A Shut-Down That Revealed Much

It was the latter part of 1937 that it became apparent that the scum in the digester was causing serious overloads on the driving mechanism and that the scum breaker arms had apparently been damaged. However, little did we realize what part corrosion was playing at that time.

To examine conditions, it was decided to shut the plant down and drain the digester and make a thorough inspection.

The sludge was transferred to the clarifier and decantation tanks for storage. This saving of sludge proved to be a fortunate thing, for it not only provided a sufficiency of seed sludge when the digester was again placed in operation, but it also supplied the real clue which led to the final solution of the corrosion problem at Terminal Island.

On entering the tank for inspection, while it was being drained, the writer felt several manhole steps bend under his feet. Later, it was found that these steps, originally ¾ inch in diameter, were eaten nearly through. On the other hand, it was of peculiar interest that some of the steps were as good as new.

As soon as the tank was clean, and safe to enter without wearing hose masks, the conditions which gave rise to the thoughts expressed in the opening paragraph were discovered. Out of all the mass of facts observed and noted only two observations seemed to be favorable. There was no indication that the concrete of the tank itself was damaged, nor was there any evidence that the steel reinforcement embedded in the concrete had been attacked.

This last fact was a good deal of a puzzle, but at the same time it was a Godsend, for if the reinforcement had been corroded, the concrete would have been cracked beyond repair and the whole tank a total loss. The effects of the corrosion were so serious and had taken place in so short a time, that it was evident that unless the cause were discovered and eliminated, the entire mechanism and perhaps the tank would soon be destroyed.

Causes Considered

Several theories were advanced as to the cause of the corrosion, none of which proved of any help in the solution of the problem. Inquiries at the time failed to reveal any similar conditions elsewhere, although some cases of corrosion in digesters have been reported more recently.

The sludge was not altogether normal, due to the presence of the fish waste already mentioned, although the pH had been consistently above 7.0. This fact seemed to eliminate the possibility of acid corrosion.

Later investigation showed that the sludge and scum were high in either soluble matter, probably high in sulphides, and extremely high in chlorides. The latter, which was due to large quantities of sea water and brine used by the fish canneries, has sometimes amounted to 2,000 ppm. in the raw sewage entering the plant during the sardine packing season and for some unknown reason is concentrated to as high as 5,000 ppm. in the sludge in the digester. These figures vary widely, the average being less than one-half the above. These facts, particularly the chlorides, undoubtedly had a bearing on the case, but were not known at the time the corrosion was discovered.

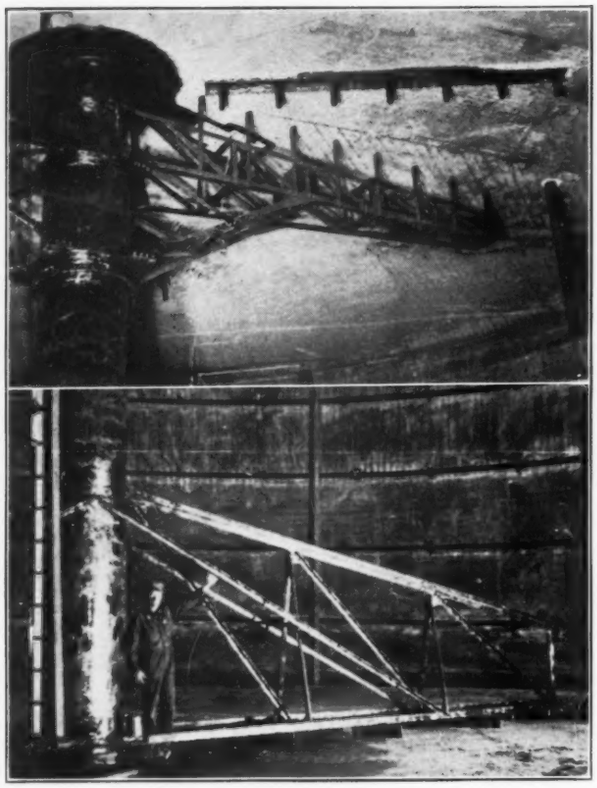
In the meantime, while the theorizing was going on, reconstruction work was under way in the digester under the direction of the writer. The original scum breaker was removed and a short, stiff truss was installed with vertical angles which meshed with stationary combs bolted to the roof. Figures I and II show some stages of this work. The hooks, which supported the hot water coils,

being no longer safe, a system of wooden racks of redwood lumber was devised by the writer. These racks were held together by birch dowels, as wood is known to be very resistant to digestion processes. Part of these pipe racks can be seen in Figure II.

The Investigations

The suggestion was finally made that the corrosion was similar to that caused by galvanic action or by electrolysis, the last being usually caused by stray electric currents. As this theory seemed to be more reasonable than most of those advanced, investigations were undertaken to find the source of such a current or currents. These studies were made while the repairs already mentioned were going on.

Alternating current is used for lighting the plant and for power to operate the digester mechanism, but all previous research has shown that alternating current is rarely, if ever, a cause of electrolytic corrosion to any serious degree.



Figs. I and II—Digester Interior

Showing mechanism protected with Bitumastic coating, which reduces current requirement and enhances efficiency in Cathodic protection. (Above)—New scum-breaker, with stationary combs bolted to roof. (Below)—Sludge-sweep mechanism and heating coils on tank walls, both protected with "Bitumastic" enamel.

A well known expert on electrolysis inspected the plant and gave the opinion that the corrosion was caused by stray direct currents from street railway operation. It was found, however, that there are no electric railways on the island and that there is no direct current produced or used in any appreciable amount. Furthermore, the only possible path by which such current could enter the plant was by the city water main. The water service pipe was disconnected and it was found that a higher electrical potential existed in the plant system than in the water main, indicating that the source of current was *inside* the plant rather than outside of it. This proved an important discovery.

At this time, the services of Mr. Otto Wiemer, Electrical Engineer of the Department of Building & Safety, of the city of Los Angeles, were obtained, who, with the writer, made an extensive series of investigations as to the source of the electric current which was apparently being generated within the plant.

A complete description of all the investigations would be far too lengthy to be included in this article. Many experiments and unsuccessful attempts were made to correlate the electrical potentials which were found to exist between the different parts of the plant. Various types of grounds were used, chromium rods, copper sulphate sponges, and what not. But the chief difficulty was the inability, with these methods, to reproduce any observed reading on two successive days.

The "Bench-Mark" Method

Finally a method was decided upon, which for want of a better name was called the "bench-mark" method. This simply consisted of using one point, a conveniently situated water faucet, as a reference point and observing the potentials—i.e., voltages, of all other points in the plant, with reference to this one point. Several hundred readings were made and recorded showing values, positive or negative, with reference to our "bench-mark." It was found that these readings could nearly always be checked quite closely when the work was repeated on subsequent days.

The equipment used for this work consisted of a very sensitive volt-ammeter, known as a Rawson Junior "Multi-meter," with full scale readings in decade arrangements from as low as two millivolts to one thousand volts and from 0.1 milliampere to one ampere. Several hundred feet of No. 12 rubber-covered wire on a spool, and numerous clips and points for making connections, completed the outfit.

It has already been stated that during the reconstruction of the digester, the plant had been shut down and the contents of the digester transferred to the clarifier and decantation tanks for storage.

The Clarifier Proves a Giant Galvanic Cell

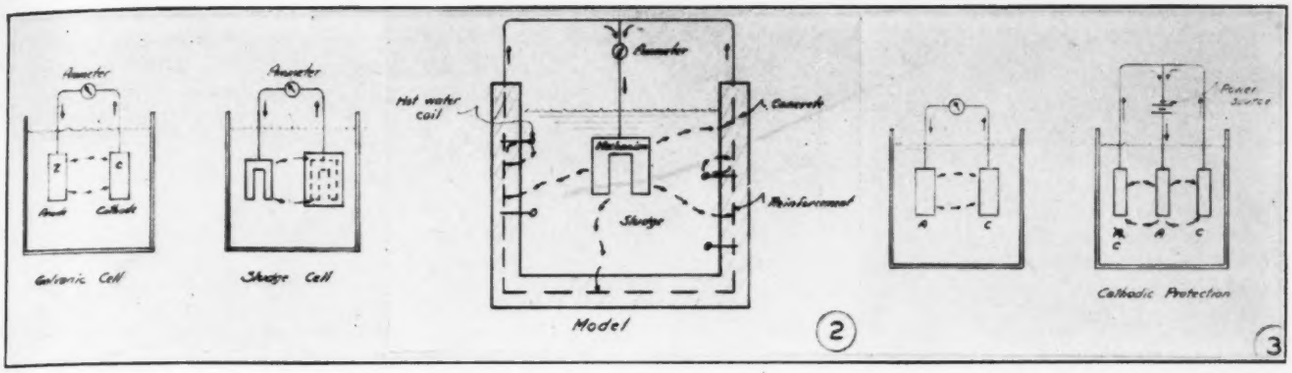
It so happened that most of the first readings were made at scattered points throughout the plant and showed only small voltages above or below the "bench mark." However, finally, a series of increasing potentials noted led to the clarifier, in which digested sludge was stored. Here a difference of four hundred millivolts (0.4 volts) was found between various parts of the clarifier piping and steel work and our "bench mark." Similar but lower differences existed between parts of the decantation tanks and the "bench mark."

The investigation was continued and readings made of differences of potential between the "bench mark" and several hundred points throughout the plant. These points included hot and cold water systems, sludge pipes, electrical conduits, exposed metal parts in tanks, reinforcing steel in various structures and even hand rails and the wire fence enclosing the plant property.

The readings varied over a wide range, positive or negative, to the "bench mark." But, from a study of all the readings, it became evident that greatest differences of potential existed between the point of reference and those tanks in which digested sludge was stored.

Figure III—a table which appears later—reveals the method of keeping the notes.

The only possible inference which could be drawn from these observations was that in some manner, not entirely clear, the said tanks were acting as huge galvanic wet cells and were actually producing direct current. This current was leaking out through many inter-connected paths throughout the plant and was returning through other paths to complete the electrical circuit.



Diagrams 1-2-3—Revealing Similarity Between a Simple Galvanic Cell and That Produced With Electrodes in Sludge Liquor, as the Electrolyte

(1) Galvanic Cell and Sludge Cells. (2) Concrete Model of Sludge Digester Used in Study of Current Flow Resulting From Galvanic Action. (3) The Simple Galvanic Cell After the Introduction of a Sacrificial Anode Between the Two Electrodes and Reversal of Current Flow. Thereby, What Was Originally the Anode Becomes Another Cathode, Thus Producing So-called "Cathodic Protection" When the Imposed Current Reverses the Flow of Ions.

In applying this "wet battery" theory to the digester, which was still undergoing repairs, it was possible to conceive that the corrosion already described could have been caused in this way, provided the corroded parts were "anodic," or positive, and some other parts were "cathodic," or negative. In galvanic action current flow is always from the positive to the negative electrode.

It is well known that when two dissimilar metals are immersed in a proper electrolyte and connected externally, a current will flow from one electrode to the other and that one of the electrodes (the anode) will pass into ionic solution in the process. Such action is known as galvanic action. It is also well known that it is not necessary to have entirely dissimilar metals, such as copper and zinc, for such a condition to exist. Even electrodes of the same material, such as iron, which by reason of difference in area, surface condition or partial protection, may be dissimilar, will behave in the same manner and one of the electrodes will be eaten away.

Laboratory and Model Studies

A number of tests made in the laboratory, using numerous samples of iron and steel, and sludge liquor for electrolyte, proved that electrolytic corrosion could take place. One test was made with two small grids of black iron bailing wire of exactly the same size and shape. One grid was used bare and the other was cast in a plaque of concrete, one inch thick. Both grids were immersed in sludge liquor and showed a definite flow of current when externally connected. Diagram No. 1 shows the well known principle of the galvanic cell and the close relation to the sludge cell which behaved in a similar manner.

FIG. III—TYPICAL NOTES OF POTENTIAL DIFFERENCES USING THE "BENCH MARK" METHOD

Location	Potential* Millivolts
6-in. C. I. pipe to east sludge beds	+ 21
2-in. W. I. pipe—sprinkler system	+ 3
Reinforcing steel — digester wall	+ 36
Wire fence—south property line	— 13
Telephone conduit—office	+ 18
Hand rail—pump house	+ 42
Discharge—high pressure wash pump	+150
4-in. C. I. suction—effluent wash at clarifier	+400**
Clarifier sludge outlet pipe	+385**
4-in. C. I. gas pipe at regulator pit	+ 32
Decanter tank—sample pipe	+108**
Decanter tank—float guide	+210**
Gas holder frame	+ 32
Digester — supernatant overflow pipe at ground line	+ 18
Reinforcing steel—venturi flume structure	+ 11

*Potential expressed in millivolts between the water-faucet "bench-mark" and the equipment listed, + meaning flow away from the unit listed.

**Digester sludge was stored in these tanks.

A model was then constructed to simulate, in principle, the construction of the digester. The model was made of concrete, sixteen inches in diameter and twelve inches high, with walls and bottom two inches thick. A cage of bailing wire was cast in the walls and bottom to represent the reinforcing steel, while a coil of wire supported inside the "pot" and in contact with the cage represented the hot water coils. The sludge stirring mechanism was represented by a grid of wire supported in the middle. Several wires were brought out for electrical connections and the "pot" was filled with sludge liquor.

Diagram No. 2 shows the arrangement of "pot" model. The parts indicated as "reinforcement," "hot water coil" and "mechanism" were baling wire.

Readings made with the sensitive voltmeter showed that current flowed through the instrument from the wire cage which was encased in concrete to the grid which was suspended in the liquor. This proved that the "pot" was acting as a battery and that a self-generated current passed from the wire grid (anode) through the liquor electrolyte to the wire cage in concrete, which was the cathode. The current passed back through an external wire to the anode, thus completing the circuit. Current also probably flowed from the wire which represented the hot water coil to the wire cage, and back to the coil through the supporting wire, although this could not be proven.

However, after exposure for about three weeks, with the cage externally connected to the grid, a noticeable amount of corrosion was found to have occurred in wire representing the hot water coil, as well as in the grid representing the sludge and scum mechanism.

It was suggested that a possible source of electric current might be the maze of piping which connects the various parts of the plant. These pipes of various materials, are for the most part, buried in the damp, salty sand of the plant site and may at times be in brackish ground water.

This theory was based on the well known fact that pipes passing through varying types of soils are subject to electrolytic corrosion. In this case, the pipes buried in the ground would be cathodic while the other ends, being in contact with the sludge in the digester, would be anodic and, therefore, would be corroded. However, the experiments with the "pot" model, already men-

tioned, proved that current was produced when the model was standing on a bench and not in contact with the ground—i.e., was in nowise grounded.

A test was made to simulate conditions to test the above theory. The "pot," partly buried in the sand, was connected to a quantity of junk iron buried nearby. This sand was well-soaked with ground water and conditions of current flow noted. It was found that a small current, probably not over 15 per cent of the total, was produced by the buried iron and the remainder (85 per cent or better) was produced inside the "pot." It was concluded that, due to the smaller relative area and to faulty electrical contact, the piping system of the plant would deliver but a negligible amount of current to the digester.

The Digester Studied

After a very careful consideration of all the foregoing evidence, it was concluded that the corrosion which had occurred in the digester had been caused by an electrolysis due to a self-generated or galvanic current within the digester itself.

Further investigation was made to find the cause of the "spotty" condition of the corrosion in the digester, particularly as to why some of the manhole steps and pipe hangers were severely attacked and some were not. It was found by passing a small electric current from a flashlight battery through the various parts, that the steps and hooks which were corroded were apparently in good contact with the reinforcing steel in the concrete walls of the tank, while those which were not corroded were in poor contact or not in contact at all. This poor contact would prevent the completion of an electrical circuit without which electrolytic (galvanic) corrosion could not occur.

It could only be assumed that the "spotty" conditions of structural steel members and some portions of the piping was caused by the fact that some of the original bituminous paint coating adhered to some areas and caused a concentration of current on the unprotected areas.

Considering the digester as a whole, the electrolytic conditions which could have caused the corrosion were now considered as being somewhat as follows:

The hot water pipes, being directly exposed to the sludge and therefore, by reason of their environment, dissimilar from the steel of the reinforcement, acted as anodes. Current flowed through the sludge electrolyte to the cathodic reinforcing steel embedded in the damp concrete and thence back to the pipes throughout the supporting hooks which were in contact with the steel. The pipes, being anodic, were eaten away. (By referring to Diagram No. 2 and imagining that the external lines leading to the ammeter represent the massive steel and concrete roof structure, the reader will have less difficulty in following the writer's explanation.)

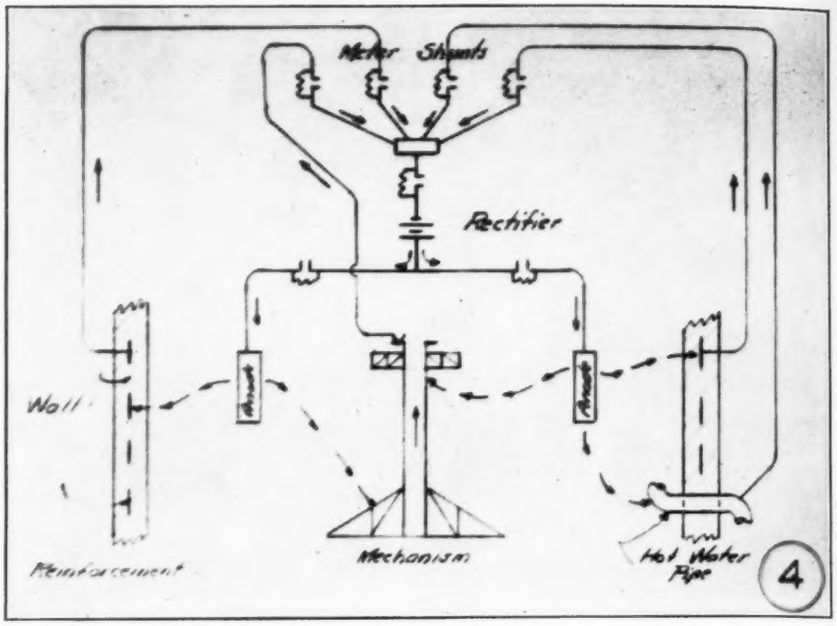


Diagram 4—Cathodic Protection Diagram as Applied to Sludge Digesters
Sketch Reveals Arrangement of Sacrificial Anodes and Reversed Current Flow Onto Metal Parts of Digester to Be Protected, and Its Return Through Metering Shunts. The Imposed Current Follows the Path of Least Resistance, Which Is to Exposed Metal Where Corrosion Is Most Active and Protection Most Needed.

In the case of the sludge stirring mechanism, the structural steel members were also anodic and current passed through the sludge to the reinforcing steel. This steel, being in contact with the roof of the tank, itself of reinforced concrete with steel beams, passed the current to the rotating sludge mechanism through the driving machinery and thrust bearings, thus completing the circuit. Here again, the steel members of the stirring mechanism, being anodic, were corroded.

While the data obtained in the investigations did not definitely prove that the corrosion had been caused in the manner above stated, it seemed that all of the facts fitted the theory and that no other theory fitted all of the facts. It was therefore decided to proceed to devise protective measures on this basis.

Protective Measures Adopted

At first, an effort to insulate the various parts was considered. This would have been extremely difficult, if not impossible, and at best would have been unreliable, due to the many possible paths for the flow of current. It could not have been accomplished without extensive reconstruction of the tank.

Protective Coating

It was decided to sand blast all of the exposed metal in the tank and to cover the parts with a good bituminous coating. After sand blasting, the parts were given a prime coat of Wailes-Dove-Hermiston Corporation's "Bitumastic" solution, followed by two coats of hot "Bitumastic" enamel, mopped on. This material produces a thick, rather rough and brittle coating but when properly applied gives good protection. (See Figures I and II.) Such a coating, however, on such surfaces, cannot be applied so as to give 100 per cent coverage and it was realized that additional protection by other means would be required. In fact it was quite likely that a 99.9 per cent covering would be worse than no covering at all. For if the cause of the corrosion was to continue unabated, all the attack would be concentrated on the uncovered areas. This would result in the prompt and complete failure of the unprotected parts.

Cathodic Protection Adopted

After considerable study and inquiry, it was decided to adapt the method known as "cathodic protec-

tion" which has for some time been used to protect oil, gas and water pipe lines from external corrosion; and more recently applied to water towers and tanks for stopping internal corrosion.

This method of protection utilizes the fact that if a metallic surface, which would otherwise be anodic and therefore subject to electrolytic corrosion, be made cathodic by externally applied direct current, that surface cannot be corroded and is therefore protected. This method is also sometimes known as "current drainage."

Diagram No. 3 illustrates the principle of cathodic protection. At the left is a simple galvanic cell, identical to Diagram No. 1. As shown, the anode would be eaten away while the cathode is unaffected. However, if another plate is inserted into the cell (Diagram 3—right) and connected to a power source externally as shown, then the new plate becomes the anode and both the original plates become cathodes. The former anode is now cathodic and is no longer corroded.

In this system, two things are apparent. The potential (voltage) of the new power source must be greater than the natural potential of the cell itself, which is usually small. Also the new anode would eventually be destroyed—sacrificed to save the other surfaces.

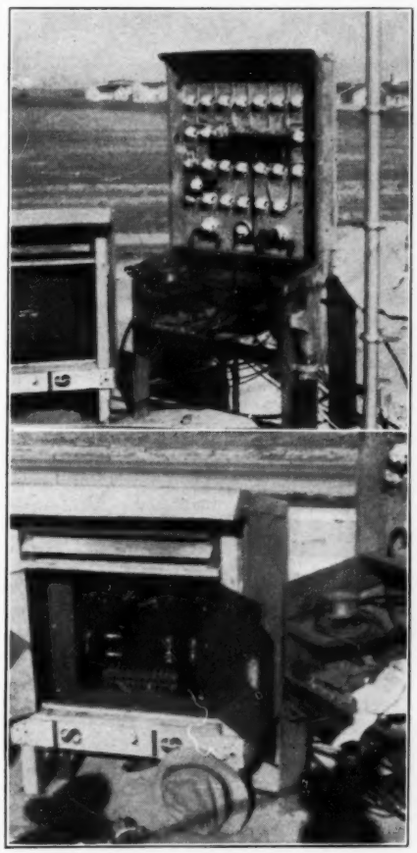
In the case of pipe lines, the pipe to be protected is connected by wire to the negative side of some direct current power source, such as a motor generator set or a rectifier unit, the positive side of which is connected to a so-called "sacrificial" anode, usually some sort of junk iron. The anode is buried in the ground at some distance from the pipe. Current coming from the power source passes first by wire to the anode, then through the ground to the pipe, returning by wire to the source. The pipe thus becomes negative to the anode and the latter is destroyed instead of the pipe. Hence the name "sacrificial." The cost of replacing the junk iron anodes is small as is the cost of power required.

It must be understood that, while theoretically such a method should provide complete protection, due to the numerous uncontrollable factors encountered in the field, the conditions causing corrosion can only be mitigated to a large extent. In any case, the life of the pipe line is greatly extended and the cost of protection is well worth while.

Application and Arrangements

While there was no precedent to be followed in the case of a sewage digester, it was felt that the cathodic-protection scheme could be used to advantage, and would reduce, if not entirely prevent, the necessity of costly replacements in the near future.

Two anodes were provided, one being hung in each of the two manholes in the roof of the digester. These anodes were steel plates eight feet long, two feet wide, and one-quarter inch thick, suspended by two one-inch diameter iron rods welded to the plates and supported from wooden frames in the manholes. The iron supporting rods were later found to be badly attacked and were replaced by two-inch by four-inch redwood hangers. The hangers were long enough so that the plates hung vertically in the upper zone or sludge with the tops about two feet below the surface. Heavy copper cables protected with heavy rubber covers were connected to the plates and carried out of the manhole top and across the roof to the central platform of the digester.



Figures IV and V—Cathodic Protection Equipment

(Above) Test Panel, With Metering Receptacles, Shunts and Ammeters. On Left Is the Rectifier Which Converts Alternating to Direct Current. (Below) The Compact Westinghouse "Rectox" Copper-Oxide Type Rectifier in Temporary Housing.

A Westinghouse "Rectox" rectifier (see Fig. V) connected to the lighting circuit provided direct current. The two anode cables were connected to the output or positive terminals of the rectifier. The return or negative terminals were connected to the main bus of a test panel.

In order to provide for definite return paths for current from the various parts of the tank to be protected, individual wires were connected to these parts and brought to the test panel. Connections were made to the hot water pipes at three points outside the tank, to all sludge and other piping, to the steel beams supporting the roof, to eight points in the steel reinforcement, to the driving machinery and by sliding brush contacts to the upper part of the stirring mechanism. In all, thirty-two such connections were made, each with its individual wire to the test panel.

The test panel (see Figure IV) consisted of a sheet of "masonite," about five feet high and thirty inches wide, in the center of which a brass bus plate was fastened. Mounted on the panel were thirty-five polarized porcelain receptacles, one for each return wire, one for each anode cable and one for the main return to the rectifier. Each return receptacle was fitted with a homemade shunt, of three ampere capacity, across the terminals and on one side was connected to the main bus plate. Each return wire was connected to its respective receptacle and correctly labeled. Twenty-five ampere shunts were fitted across each anode cable receptacle and a fifty ampere shunt was fitted across the main return receptacle.

Two ammeters were provided, each with cords and polarized plugs attached, one ammeter reading to three amperes positive or negative, the other reading to one hundred amperes, positive.

Diagram No. 4 shows the schematic arrangement of the various parts of the protective system. For simplicity, only four of the return connections are shown. The supply circuit to the rectifier is not shown. The supply is 120 volt, 60 cycle, A.C. current, only about 60 watts of energy being used all told.

When the apparatus is in operation the circuit is as follows: Current leaving the rectifier passes through the anode shunts to the anode plates. Thence it passes into the sludge and to the hot water coils, stirring mechanism, reinforcing

steel and other metal parts. From these parts it goes by the individual return wires to the receptacles on the test panel, and through the shunts to the bus plate. From the bus plate it passes through the main return shunt to the rectifier.

The purpose of the shunts is to provide for measuring of the current without interrupting the circuit. The anode shunts permit the current passing to each anode to be measured separately. The individual shunts permit measurement of the current returning from each part of the tank to be protected. The main return shunt provides for measurement of the total current returned and serves as a check on the other readings. The readings on the individual returns permit these circuits to be balanced in approximate proportion to the area to be protected, and also indicate whether the connections are in good condition.

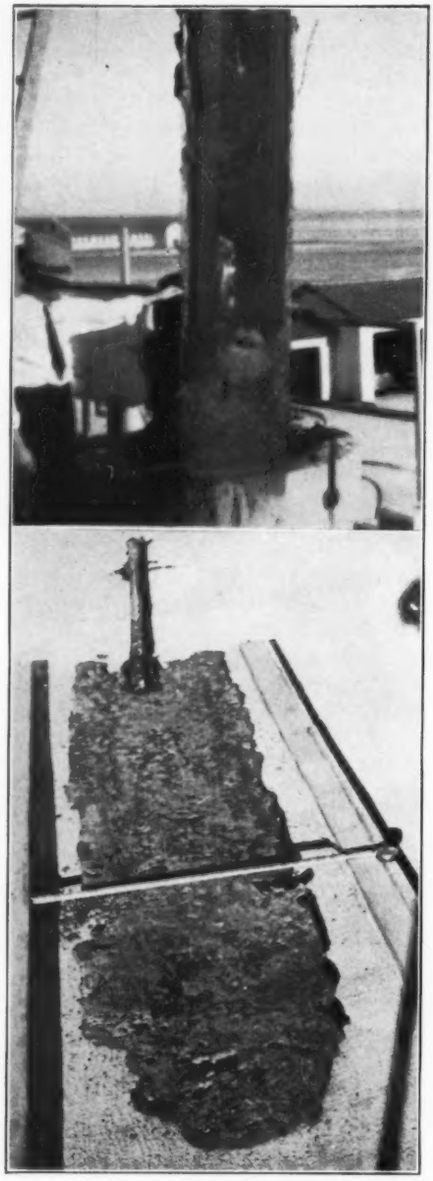
The rectifier has a capacity of 30 amperes at 3.2 volts, direct current, and is so designed that several combinations of voltage and amperage may be obtained. However, experience dictates that those tappings which produce 20 amperes at 2.2 volts should be used; and, thereby, the total power used is only that required for a medium size electric light. One-half the current is sent to each anode and the return circuits are balanced to carry from 0.25 to 1.5 amperes each. Readings are made and recorded periodically to note changes.

The Anodes

The steel-plate anodes are hoisted out for inspection from time to time and are replaced as needed—(see Figure VI). When removed, the plates are found to be covered with a black honeycombed crust about two inches thick, while underneath the crust the plates are deeply pitted and eaten away at the edges. The wooden hangers are not affected. The crust does not seem to affect the operation of the plate as an anode. One pair of plates, originally weighing 195 pounds each, were found to weigh 90 pounds each, after fourteen months of service. Each plate lost, therefore, 105 pounds or 7.5 pounds per month. This equals approximately 9 pounds of iron per ampere per year. Figure VII shows the condition of an anode, after final removal. This plate has been left in service too long. It is probable that the anodes should be replaced after nine to twelve months' service.

Costs

The cost of the installation was about $200.00, of which $140.00 was for the "Rectox" Westinghouse rectifier. This cost does not include labor, which was done by the plant operators, under the supervision of the writer. It is indicated that anode replacements will cost $10.00 to $15.00 per year, depending on conditions. The power cost is truly negligible.



Figures VI and VII—The Inexpensive Sacrificial Steel Anode
(Above) Hoisted Out for Inspection, Note Crust Adhering to Plate. (Below) An Anode After 14 Months of Service; Little Being Left But Metal Lace and Wood Frame. Frame Strips Show Original Size of Anode.

Most of the anti-galvanic cathodic protection equipment was put in operation about the middle of December, 1938, using a homemade motor-generator set for power supply. The "Rectox" unit was purchased and installed later.

Results

It is unfortunate that no definite information can be given at this time as to the results of this method of protection, as no opportunity has occurred to make a complete inspection of the interior of the digester. Three things, however, seem to indicate that the protection has been effective.

First; on May 5, 1939, after about five months of operation, an inspection was made of the scum and upper mechanism in the digester, and the previously attacked parts of the scum breaker truss was found to be in excellent condition, the Bitumastic coating being intact. This indicated that no noticeable corrosion was taking place in this part of the mechanism.

Second: If the corrosion had continued at the alarming rate that it had during the first fourteen months, it seems highly probably that some of the structural parts of the mechanism would have failed entirely in the nearly two years of operation since the protection was installed.

Third: After the digester was replaced in operation, a small amount of sludge was noticed in the hot water system, which indicated a small leak inside the digester. It is probable that the original corrosion, followed by the sand blasting, had perforated the pipe in one or more places. The amount of make-up water required by the system has slowly increased, but only recently has it reached a serious amount. The system can no longer be kept full of water and is shut down pending repairs. Here again it is certain that the piping could not have been kept in service for two years longer, if the preventive measures had not been effective.

It was gratifying to note that, when for test purposes, the rectifier was shut off, the current in certain of the individual return circuits immediately reversed. This was exactly what was to have been expected from the results of the experiments with the "pot" model, indicating that the conclusions drawn therefrom had been correct. It also indicated what might have been expected if anti-galvanic protection had not been applied. Further than that, it indicated that all spots could not be reached with the protective coating applied to the metal parts in place.

As to the reason why this particular digester should have been attacked, while many other similar installations have operated for years without trouble, one significant fact stands out. The high chloride content of the sludge, already mentioned, is the only characteristic which differs from normal sludges elsewhere, and which is likely to

have any bearing on the case. A saline solution is a good conductor of electricity and would provide a good electrolyte. It is possible, in fact, very likely, that in other plants where digester corrosion has occurred, it will be found that high salinities exist, due to industrial waste, saline ground water infiltration or presence of sea water. This same saline content, however, renders cathodic protection the more readily attainable with fewer electrodes and smaller current consumption, because the liquid in a digester is a better conductor than waters low in mineral content.

The Future

In the near future it is planned to install new sludge mixing equipment and new vertical type heating coils in the digester, to convert it into the first stage of a two-stage system which will involve use of the decantation tanks as secondaries. When the tank is emptied for this work, a complete inspection will be made. It is entirely possible that many changes in both theory and procedure will be found necessary, but in any event it is our intention to make the results of this inspection and subsequent opinions, or changes in procedure which may appear desirable, public at a later date.

In the meantime, the writer hopes that others will interest themselves in the matter of possible electrolytic corrosion, not only in digesters, but in other units of treatment plants as well. Several valuable suggestions in regard to the subject have already been made. Dr. Richard Pomeroy, former Chief Chemist of the Los Angeles County Sanitation Districts, has stated that high sulphides may also cause corrosion and he points out the possibility "that cathodic protection may be used to prevent or greatly reduce corrosion, even if extensive electrolysis is not the cause." Comments and suggestions will throw more light on this little understood but important subject.

Acknowledgments

The writer is indebted to Mr. Otto Wiemer, earlier mentioned in this paper, for his assistance in the field and laboratory and the solution of the problem was in a large measure due to his wide knowledge of the fundamentals of electrolysis and electricity in general. The plant operators, particularly Mr. Fiscus, Chief Operator, deserve praise for their help and ingenuity in solving many problems of application.

The Terminal Island Sewage Treatment Plant is part of the sewer system of the city of Los Angeles, California, and is operated under the Board of Public Works. Mr. Lloyd Aldrich is City Engineer. Mr. H. G. Smith is Engineer of Sewer Design and the writer was, at the time of these investigations, Assistant Engineer in charge of plant operation.

"SEWAGE TREATMENT WORKS"

By C. E. KEEFER, Prin. Asst. Engr., Bureau of Sewers, Baltimore, Md.

PUBLISHER—McGRAW-HILL BOOK CO., New York, N. Y.

(609 PAGES—ILLUSTRATED—$6.00)

At the close of 1940 a new book (first edition) appeared on "Sewage Treatment Works" and their operation. We understand that this book, authored by an engineer in charge of both large and small sewage treatment plants of an important American city, which pioneered in sewage treatment back in 1911-1912, was written with the sewage works operator foremost in mind. It was several years under preparation and the production evidences the painstaking and time consuming searches made by the author through the literature and numerous printed reports, covering research operation and plant performance.

In the end individual chapters had the benefit of review by leading authorities, best equipped to criticize and suggest revisions where needed.

The net result is that Mr. Keefer has assembled within the 609 pages of his first book an unusually good and complete summary of information on those processes of sewage treatment which are widely used and accepted by the profession; i.e., screening, sedimentation, trickling, and sand filters, activated sludge, chemical treatment, chlorination, sludge digestion, elutriation, filtration and incineration. Each chapter opens with a picturized introduction describing the process and units of equipment and mechanisms used in connection therewith. The book might have been considerably shortened without impairing its usefulness if these descriptive portions could have been left out, since this information is already available in several earlier texts. However, to write a chapter on operation, which can be considered complete for the new reader, some description of what is to be operated seems necessary, even though it is repetition of what has seemingly been written in each book published on the subject of sewage disposal.

In the thirty-three chapters are 177 tables of data and 167 figures or graphs, making for a readily comprehended presentation of plotted data taken from published literature, committee reports of the American Society of Civil Engineers, and from Annual Reports of Operation from representative plants. These numerous tables and figures constitute perhaps the best basis of recommendation the book can have. They represent a wide and valuable summary of published data in the literature. On the whole the result is most satisfactory, although occasionally one wishes the data had been somewhat more critically edited by the author.

Many quotations from the works of prominent men in the field are given and each chapter is followed by a bibliography totaling 751 useful references to the literature, 114 such following the chapter on Activated Sludge.

The book is exceptionally well indexed, there being about 7,000 items listed in the 62 page Index. The last eight chapters cover important topics on odor control, pumps and pumping stations, measuring equipment, health and safety, plant beautification, operation and cost records.

Like "Gone With the Wind," the book seems too voluminous yet it contains only half of the advice on operation that an operator would like to have. The reader will be both pleased and disappointed with the book, pleased with the chapters about which he knows the least and disappointed with some of the information in the chapters about which he knows the most. However, it is this reviewer's opinion that Mr. Keefer has tried bravely and *well* to cover a hard task and a wide field. The book will be at home in one's library, alongside of other outstanding books in the field of sewage treatment.

W. D. HATFIELD,*
Decatur, Ill.

[*The reviewer is Sup't of the Decatur Sanitary District. Appreciation of his critically analytical mind, and as one not disposed to be a "sugar-coater," he was chosen to review Mr. Keefer's "Sewage Treatment Works" from the viewpoint of widely read plant operator of long experience. To us the highest recommendation is found in the terse comment in Mr. Hatfield's accompanying letter—"I was well pleased with Mr. Keefer's new book, and am glad that you asked me to review it." L.H.E.]

THE ESTIMATION OF TOTAL SOLIDS IN SLUDGES BY CENTRIFUGING

By GEORGE E. SYMONS
Chief Chemist
and
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AT the spring meeting of the New York State Sewage Works Association, held in Syracuse in June, 1940, the question was raised as to whether there was a satisfactory method of centrifuging sludge samples and estimating the dry solids content therefrom without evaporation, weighing, etc. In the account of this meeting, WATER WORKS AND SEWERAGE[1] reported that the Bird Island Laboratory here in Buffalo used the formula

$$\frac{\text{per cent volume of centrifugal solids}}{4} = \text{per cent solids by weight.}$$

However, it was warned that this factor of 4 was not exact and might prove to be something different for sludges of other plants.

Interest in this question has led us to summarize the data on the volume of centrifuge solids and its relation to total dry solids. This attempt to develop a relationship consisted of plotting the data collected over a period of 12 months on daily analysis of raw and digested sludge.

Reference to the literature indicated that Smith[2] at the Calumet Sewage Treatment Works at Chicago had tried this method of centrifuging for the determination of total solids in activated sludge. It was reported that the use of 100 ml. and 50 ml. tubes was not practical because the graduations were not close enough. Smith developed a 30 ml. centrifuge tube graduated to 0.1 ml. divisions for the first 10 ml. Samples were centrifuged in a closed motor driven centrifuge for three minutes after uniform speed had been raised to 2,000 R.P.M., followed by a gradual stop. It was observed that an increase or decrease of approximately 130 R.P.M. from 2,000 R.P.M. caused a difference in reading of from 0.1 to 0.2 ml. in the volume of the sludge and that the "main cause of variation is the non-uniformity in the character of the sludge particles." As evidence of this, the variation in mineral matter after heavy rainfalls was cited. It was concluded that the "centrifuge test is probably satisfactory enough for rough plant control work, but as a matter of record, should be supplemented by actual gravimetric solids determination."

Technique of the Centrifugal Method

The technique of the test as carried out in the Bird Island Laboratory consists of the following steps:

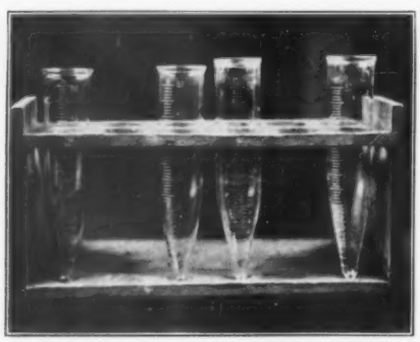
Measure 50 ml. of sludge sample into a standard conical bottom 50 ml. centrifuge tube. Place the tube and a balancing tube in the centrifuge, and set the rheostat to control the maximum speed to 2,000 R.P.M. The time control is set and the current switched on. After 15 minutes the current is switched off and the centrifuge allowed to coast to a stop. The volume in ml. of sludge solids in the centrifuge tube is read and multiplied by a factor of 2 to give per cent by volume of centrifuge solids. It is probably safe to say that the reading accuracy is $\pm$ 0.3 ml. when the heterogenous character of the sludge is considered, for the surface of the compressed solids is usually quite uneven.

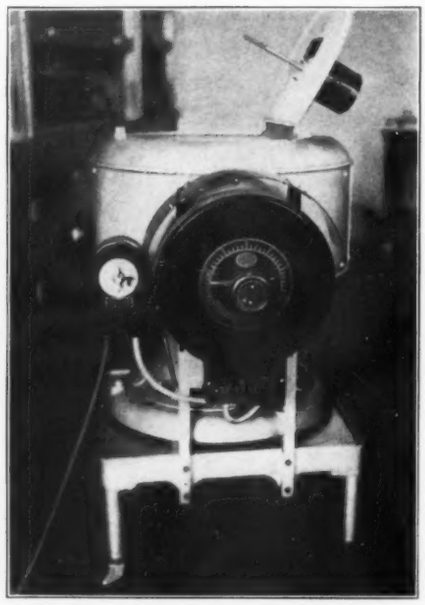
In the study of our own data, it appeared that any plot of the data would give a general scatter diagram with an upward trend. Observations had confirmed Smith's findings of the effect of character of sludge particles on the volume of the centrifuge solids. Therefore the decision was made to plot the data according to ranges of volatile matter in order to take into account this factor which involves density of the particles.

What a Study of Analytical Data Revealed

Table I for raw sludge shows the relationship of per cent centrifuge solids by volume to per cent total solids by weight, for such sludge in several ranges of volatile matter content. Table II shows similar data derived from analyses of digested sludges. The ratio of per cent centrifuge solids by volume to per cent total solids by weight is plotted in Fig. 1 against per cent volatile matter for both raw and digested sludge.

From a study of these curves, it is apparent that with an increase in volatile matter the sludge becomes more bulky and a given weight occupies a greater volume. This is true for both raw and digested sludge; and, since it is reasonable





Equipment Used in Centrifugal Solids Determinations.
50 ml. tubes; centrifuge with speed control element and timing cut-off switch; raw and digested sludges before and after centrifuging.

to expect that the density of sludge particles will vary inversely as the organic content, such is to be expected.

What Plotted Data Reveals

These curves indicate that for the same volatile matter content *digested sludge is more bulky than raw sludge.* At first thought this appears to be contrary to expectations. The explanation, no doubt, lies in the fact that when the volatile matter content of raw sludge decreases toward that of digested sludge, the ash increase is due to fine sand. This condition occurs during storms. Naturally, the density of the sand and silt is quite high and the raw sludge is less bulky than digested sludge of the same organic-inorganic composition, but different types of components.

Although the slope on these curves is slightly variable, it is probably safe to assume that if more observations were available, the curves would tend to become straight lines. This deviation from a constant slope appears to be more pronounced in the case of raw sludge. Such a condition is probably due to the fact that raw sludge is more heterogenous and samples are more apt to contain disproportionate amounts of large particles of non-uniform density.

Developing a Factor

Quite obviously, then, the use of a definite factor to convert centrifuge solids to total solids by weight is not permissible. If the assumption is made that these lines have a constant slope represented by a straight line drawn through the points, then formulae may be developed to show the relationship as follows:

TABLE I—RAW SLUDGES

Ratio of Per Cent Centrifuge Solids by Volume to Per Cent Total Solids by Weight at Various Contents of Volatile Solids

$$\text{Ratio} = \frac{\%\ \text{Cent. Sol. by Vol.}}{\%\ \text{Total Sol. by Wt.}}$$

No. of Observations	Vol. Mat. Range Per cent	% Vol. Mat. Avg.	% Vol. Mat. Median	Ratio Max.	Ratio Min.	Ratio Avg.	Ratio Median
22	40-50	45.0	47.0	4.164	2.224	3.022	2.950
39	50-55	52.8	52.9	4.516	2.764	3.400	3.410
43	55-60	57.7	57.5	4.954	2.898	3.808	3.808
45	60-65	62.4	62.5	6.666	2.080	4.120	4.408
62	65-70	67.4	67.3	6.250	2.250	4.200	4.326
98	70-75	72.5	72.4	7.006	2.722	4.740	4.802
59	Over 75	78.4	77.3	7.660	2.858	5.156	5.284
368	40-91.6	65.9	67.7	7.76	2.224	4.120	

Average of 368 Observations—

Per cent Cent. Solids.....23.90
Per cent Total Solids 5.80
Per cent Volatile Matter.....65.9
Ratio 4.12

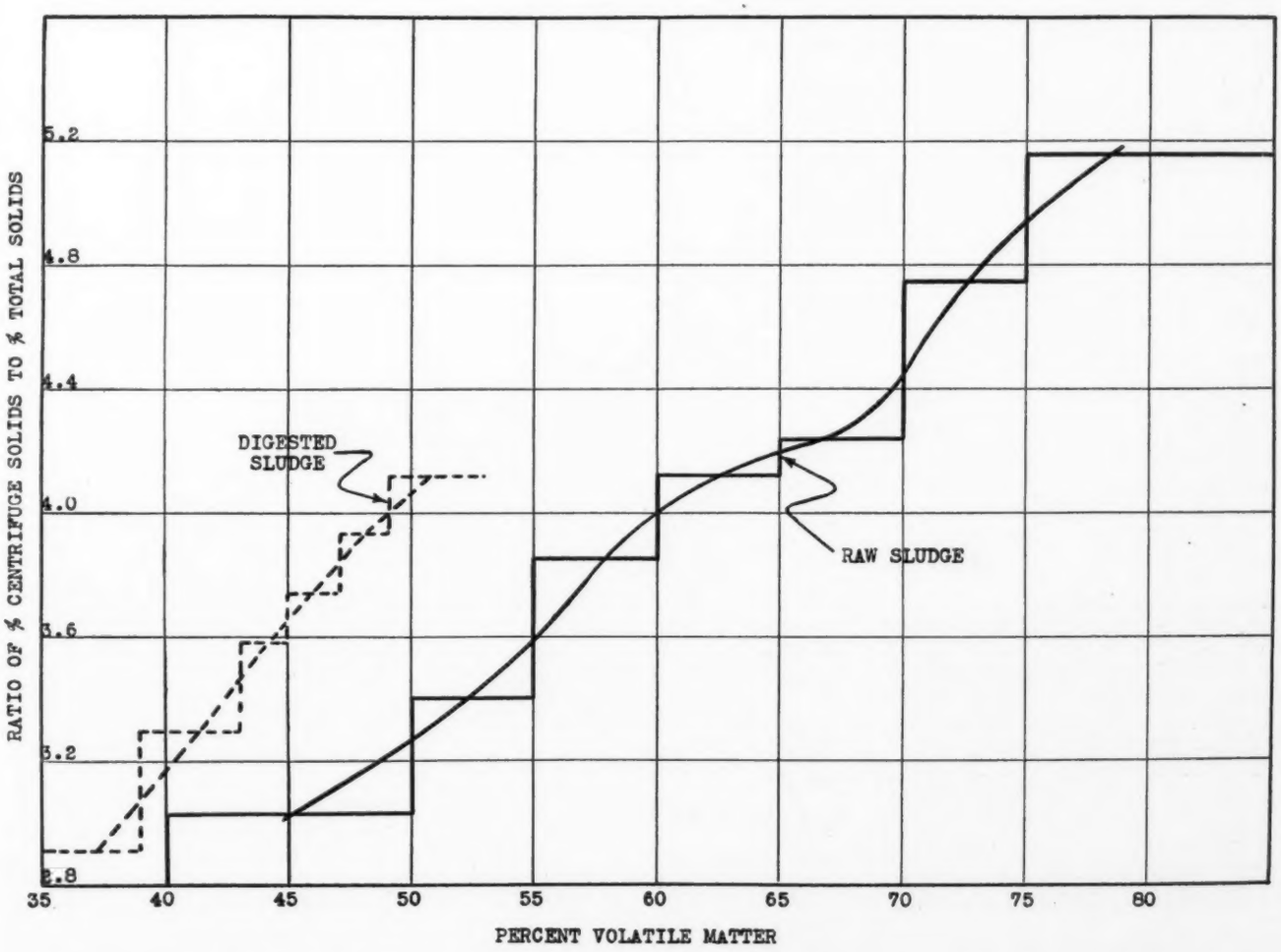


Fig. I—Changing Ratio of Centrifuge Solids to Total So lids, as Influenced by Per Cent Volatile Matter in Sludges

TABLE II—DIGESTED SLUDGES

Ratio of Per Cent Centrifuge Solids by Volume to Per Cent Total Solids by Weight at Various Contents of Volatile Solids

$$\text{Ratio} = \frac{\%\ \text{Cent. Sol. by Vol.}}{\%\ \text{Total Sol. by Wt.}}$$

No. of Observations	Vol. Mat. Range Per cent	% Vol. Mat. Avg.	% Vol. Mat. Median	Max.	Min.	Avg.	Median
62	35-39	37.2	37.0	4.444	2.136	2.904	2.884
54	39-43	41.3	41.5	4.232	2.636	3.294	3.210
49	43-45	44.1	44.2	4.436	2.744	3.580	3.616
53	45-47	45.8	45.7	5.064	2.462	3.738	3.836
47	47-49	48.0	48.2	5.000	2.500	3.930	3.938
49	49-53	50.7	50.7	5.156	2.602	4.118	4.058
316	35-53	43.9	43.4	5.156	2.136	3.424	

Average of 316 Observations—

Per-cent Cent. Solids 33.52
Per cent Total Solids 9.79
Per cent Volatile Matter 43.88
Ratio 3.424

(A) For Raw Sludge:

The ratio at any given volatile matter content is:

$$\text{Ratio} = 2.7 + (\%\ \text{vol. mat.} - 35) \times 0.09$$

or

$$\text{T. S. (by wt.)} = \frac{\%\ \text{cent. sol. by vol.}}{2.7 + (\%\ \text{vol. mat.} - 35) \times 0.09}$$

(B) For Digested Sludge:

$$2.7\ (\%\ \text{vol. mat.} - 35) \times 0.09$$

The ratio at any given volatile matter content is:

$$\text{Ratio} = 2.7 + (\%\ \text{vol. mat.} - 40) \times 0.06$$

or

$$\text{T. S. (by wt.)} = \frac{\%\ \text{cent. sol. by vol.}}{2.7 + (\%\ \text{vol. mat.} - 40) \times 0.06}$$

The accuracy of these factors determined from the slopes of the curves is well within the accuracy of the reading. This is apparent when one notes the spread of maxima and minima and when one considers the reading error for the final result may itself have an absolute error of 2 to 6 per cent in sludges ranging from 4 to 12 per cent total dry solids.

Value of the Test

Inasmuch as it appears that the volatile matter of the sludge involved must be known, the question may well be asked, "Why run the test if total solids and volatile matter must also be determined?" The answer is that the test is only applicable when an operator has an idea of the approximate composition of the sludge and desires a quick estimate of the concentrations of solids in a sludge. For example, a very quick inventory of sludge tanks can be made by the use of this test.

The value of this study has been to demonstrate that:

1. There is a relation between the volatile matter content of sludge and the ratio of the volume of centrifuge solids to solids by weight.
2. The use of the test must be based on standardization for each sludge analyzed.
3. Final results of total solids by weight determined in this manner are only approximate.
4. The preliminary choice of a factor of 4 for digested sludge at Buffalo[1] was approximately correct.
5. Smith's conclusions[2] that "the centrifuge test is probably satisfactory enough for rough plant control work, but as a matter of record, should be supplemented by actual solids determinations," applies to raw and digested sludge as well as activated sludge.

REFERENCES

1. Water Works and Sewerage, **87**, p. 319 (1940).
2. Smith, J. I., Investigation of Rapid Methods for Sludge Solids Estimation, Sewage Works Journal, VI, 908-19 (1934).

ON PUMP EFFICIENCIES

Dear Sir:—

I have just finished reading the January issue of WATER WORKS AND SEWAGE and cannot agree with the calculations of Mr. W. F. Schaphorst regarding method of calculating the increase in the efficiency of pumps.

If a pump with a 74% efficiency is replaced by one with an 85% efficiency, the increase in efficiency is in reality 14.9% and not 13%, as calculated by Mr. Schaphorst.

The following are the calculations for determining the increased efficiency:

$$\frac{.085 - 0.74}{0.74} \times 100 = \frac{0.11}{0.74} \times 100 = 14.9\%$$

Furthermore, if a pump with a 40% efficiency is replaced by one with an 80% efficiency, the increase in efficiency is 100% and not 50%.

Yours very truly,
C. E. Keefer, Baltimore, Md.

HOW TO COMPARE PUMP EFFICIENCIES

(In which the author explains the basis of the Method.)

The editor of WATER WORKS & SEWERAGE has very kindly forwarded to me C. E. Keefer's criticism of my method of comparing pump efficiencies and the chart as published in the January issue.

In writing my article I studiously avoided the expression "increase in efficiency" because it cannot be translated directly into fuel savings. Most users of pumps are interested primarily in power saving or fuel saving, which I called the "improvement."

For example, if a given pump has an efficiency of only 50 per cent, that means that two h.p. are required to create an output of one h.p. Efficiency is equal to output divided by input.

Now replace that pump with one having an efficiency of 100 per cent and we will have an input of one h.p. and an output of one h.p.

The "saving" in power is one h.p., which is 50 per cent of the power formerly used.

It is true, of course, that the "increase in efficiency" is 100 per cent in accordance with Mr. Keefer's formula, but that figure is of less value to the pump buyer and operator than the figure that gives the true saving or "improvement."

Column C of my chart is labeled "Power Saving—Per Cent." It could have been labeled "Improvement" just as well, but in developing the chart I thought the wording "Power Saving" would convey the meaning more clearly.

Contributed by W. F. Schaphorst, M. E., Newark, N. J.

COMBINATION PLANT TREATS SEWAGE AND TANNERY WASTES AT MIDDLESBOROUGH, KY.

Financed by Sewer Rentals Plus Contract with Tanners

By J. SANDERS PARKER, Chief Engineer
J. STEPHEN WATKINS, Consulting Engineers
LEXINGTON, KENTUCKY

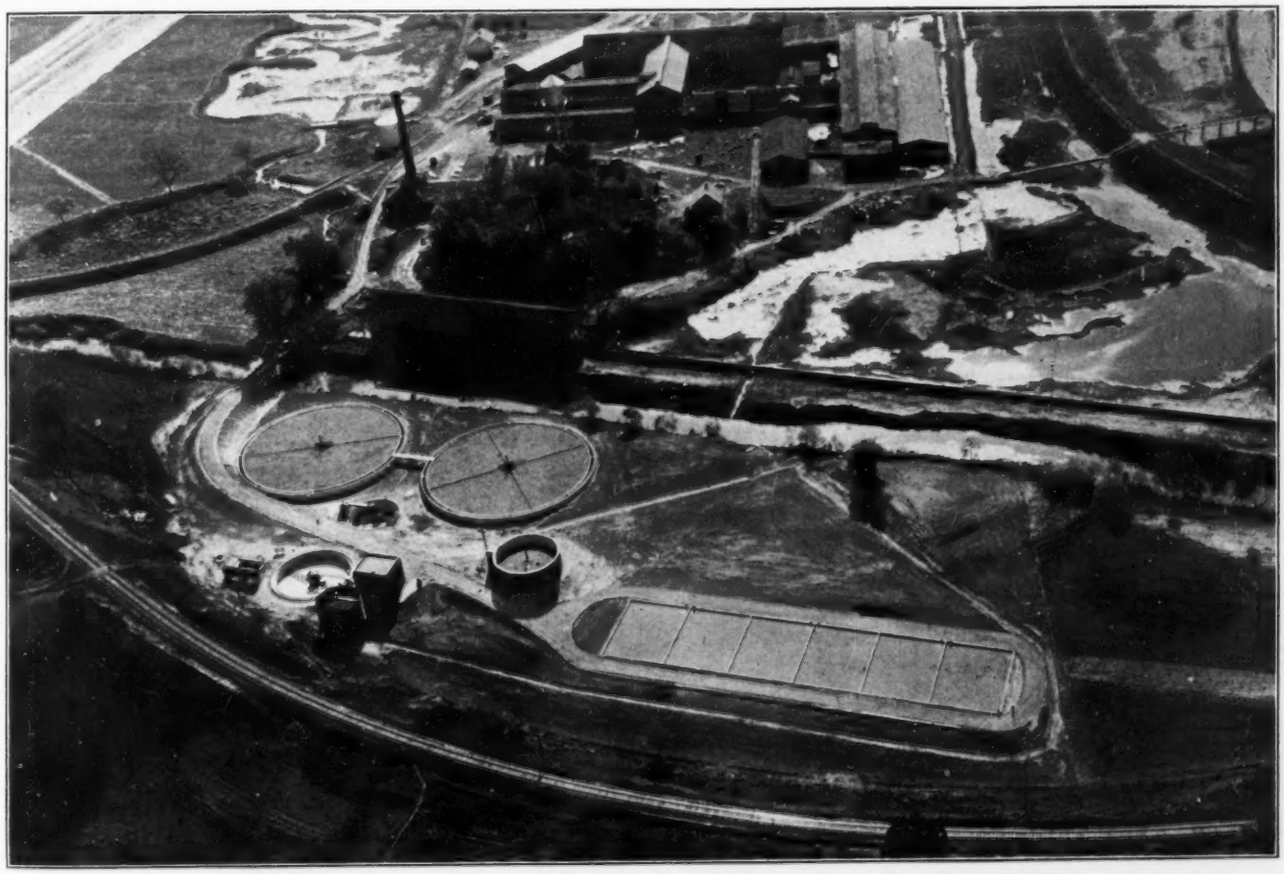
THE City of Middlesborough is located in a mountain basin in the southeastern part of the State, approximately two miles west of the historical Cumberland Gap, where the boundary lines of Kentucky, Virginia and Tennessee meet. This mountain basin was formerly a large lake and the floor of the basin is composed of sedimentary deposits containing areas of quick-sand or running sand.

The valley in which Middlesborough is located is drained by Yellow Creek, which flows into the Cumberland River approximately ten miles from the city. At the time Middlesborough was founded, under interesting circumstances later revealed, the course of Yellow Creek was straightened and carried through the business district of the town as an open canal. It has been the custom in the past to discharge all domestic and industrial waste into the canal at various points along its course through the city. It is hardly necessary to state that, in consequence, there existed a very bad sanitary condition in Middlesborough, for the correction of which the city has recently finished the construction of a complete sanitary sewer system and sewage treatment plant.

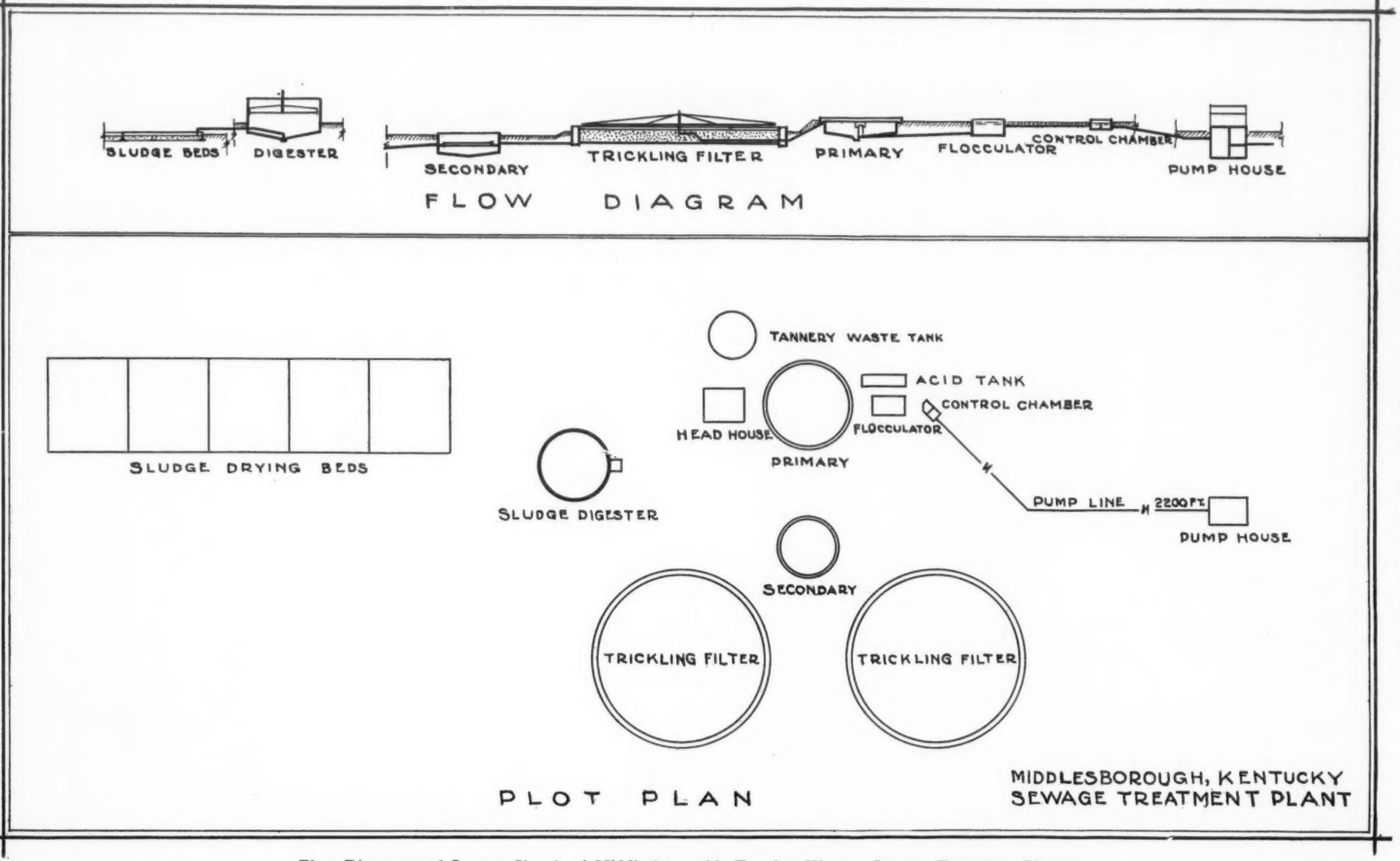
The Author

Some Interesting History

Cumberland Gap and the mountain basin in which the City of Middlesborough is now located were discovered in 1750 by Dr. Thomas Walker of Virginia. In 1887 Alexander Allen-Arthur, a Canadian lumberman, visited Cumberland Gap to prospect for the natural resources originally reported by Dr. Thomas Walker. He found in this locality large deposits of coal, iron ore and limestone, and succeeded in securing the aid of financial interests in Great Britain for the construction of an



Middlesborough's Combination Sewage and Waste Treatment Plant from the Air.
Across the Canal from the Plant is the Union Tanning Co., the wastes from which the city treats in the new plant on a contractual basis.



Flow Diagram and Layout Sketch of Middlesborough's Tanning Waste—Sewage Treatment Plant.

Tanning wastes, received and stored in an equalizing tank, are fed to the plant at desired rates. Liquor or sludge from the final clarifier may be returned to the head of the plant to effect any desired dilution or to maintain more uniform filter loadings.

industrial and commercial city on Yellow Creek near Cumberland Gap to be named Middlesborough. British engineers, sent to lay out the city, the railroads and utilities, planned the new city for a population of 150,000. Blast furnaces were constructed and operated for some years, and, while the deposits of coal were of excellent quality and large in extent, the deposit of iron ore proved to be of too low grade and the quantity insufficient to successfully compete with iron ore from other deposits. Therefore, the development of this city halted far below the expectancy of its founders. The present population of Middlesborough is approximately 12,000.

At the time of the founding of Middlesborough, a combined sanitary and storm sewer system was planned and the main outfall line was partially constructed at a sizable cost. This system, however, was never completed, due to financial reverses of the banking house of Barring Brothers in London, which was the chief financial support of the Towne Lands Company, which undertook the construction of this utility. The present busy community is an industrial and mining center.

The New Sewerage System

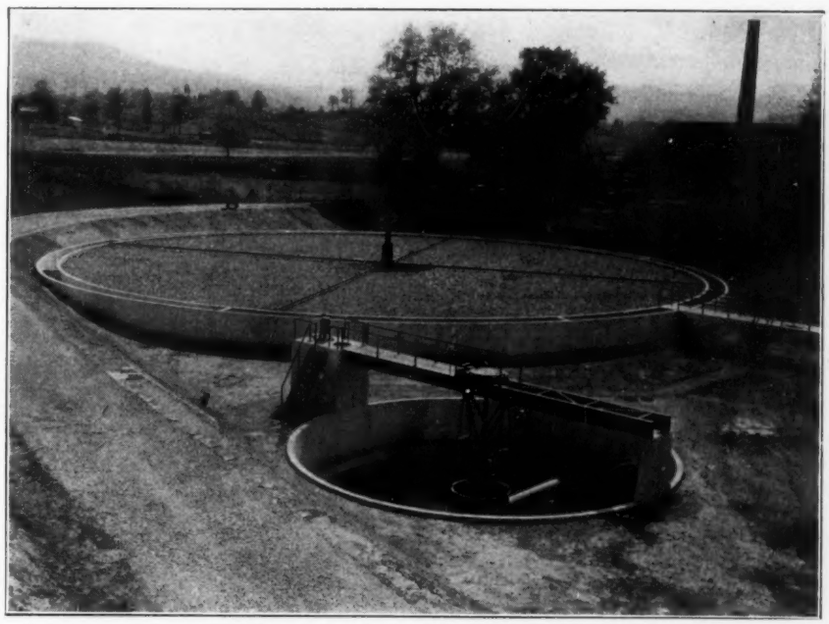
A sanitary sewer system and sewage treatment plant to serve this city was constructed recently at a total cost of $425,454. The project was started on January 1, 1939, and was completed on July 24, 1940. It is beyond the scope of this paper to discuss the problems of design and construction of the Collecting System, so its context will be confined to the design of the Treatment Plant. The problem was somewhat complicated by the need for treating the combination of tannery wastes with the domestic sewage. In consequence, the type of plant provided was designed for separate sludge digestion with the added facilities for employing chemical precipitation. Secondary treatment is provided by trickling filters.

Design Basis

The population of Middlesborough, according to the 1930 census, was 10,350. As a basis of design of the plant, the population was assumed at 13,000.

The total flow at the plant was determined by allowing for 60 gallons per capita per day assumed to reach the plant during a 16 hour period. This figure was taken as the average maximum flow to be handled by the plant. This would give a flow of 1,168,000 g.p.d. The average daily water consumption in 1938 for the City of Middlesborough, as obtained from the Kentucky Utilities Company's records, was 484,800 g.p.d. Converting this average water usage to the 16 hour basis would give a rate of flow of 726,000 g.p.d. Allowing for infiltration to the system of 10,000 gallons per mile per day for the 30 miles of sewers and laterals (or 300,000 g.p.d.), would give a total of 1,026,000 g.p.d. As this checked well with the assumed flow of 60 gallons per capita per day, the daily flow obtained from that assumption was used in the design.

It was impossible to obtain a representative sample of the domestic sewage for analysis as there was no complete collecting system in the city, therefore for the purpose of design of the trickling filters and sludge digester the domestic sewage was assumed to have a 5-day BOD of 350 p.p.m. Reducing the tannery waste to a population basis on the above assumption, gives a total equivalent population of 20,700 based on suspended solids and a total equivalent population of 15,500 based on 5-day BOD.



One of the Twin Trickling Filters and Final Settling Tank in Foreground. *Note annular inspection gallery around the filters which are designed for fly control by flooding. Two of the four distributor arms automatically function or cease functioning with increase or decrease of flows. Note the elevated location of drive motors for clarifier mechanism and sludge pump (left) at a height above maximum known high water line.*

Tannery Waste

The city of Middlesborough contracted with the officials of the Union Tanning Company, Inc., to treat the waste from their Middlesborough plant at the city sewage treatment plant. This waste is pumped to the treatment plant by the Union Tanning Company, whose plant is located directly across Yellow Creek from the plant—see air view. The tannery employs the vegetable tanning process and the total amount of waste from this plant is approximately 90,000 g.p.d. The nature of this waste is such as to seriously complicate the design of the plant. An analysis of the tannery waste shows the total solids to be 8,350 p.p.m.; suspended solids, 1,750 p.p.m.; volatile solids, 3,300 p.p.m.; 5-day BOD, 830 p.p.m; total alkalinity, 1,155 p.p.m.

Pump Station

The main outfall sewer was located along the canal bank and was carried on a minimum grade to a point 2,200 feet above the treatment plant. At this point the outfall sewer was at a grade approximately 1 foot above the dry weather flow in the canal. Our studies showed that it was neither desirable from the standpoint of underground conditions nor sound from the standpoint of economics to carry the gravity line further. And, since it was necessary to lift the entire flow at some point near the plant to get it to required plant elevation, this point was selected for the pump station. From this point the entire sewage flow from the city (not including tannery waste) is pumped through a 14-inch cast-iron pressure line 2,200 feet to the treatment plant. This

is the only pumping station in the entire system. At the entrance manhole to this pumping station there is constructed a by-pass to the canal. This by-pass is protected on the canal side by a flap gate and will permit sewage flow to by-pass in case of a power failure. Located in the pump house is a comminutor and bar screen chamber, the bar screen serving as a by-pass in case of power failure or mechanical failure of the comminutor.

The sewage, after passing the comminutor, drops into a pump pit having a capacity of 5,700 gallons. The three pumps in the dry pit in this station, with capacities of 300, 500 and 700 g.p.m., are of the vertical non-clog type, and are controlled by automatic float switches. Since the discharge from these pumps is direct to the control chamber, it was thought desirable to so adjust the capacity of the pumps and the sequence of operation as to reduce surges in the long discharge line to a minimum. Therefore, an automatic float switch was installed to provide sequence of operation as follows:

When the level of sewage in the pump pit reaches a pre-determined elevation, the 300 g.p.m. pump is started. If the sewage continues to rise above this level the 500 g.p.m. pump is started and the 300 g.p.m. pump is stopped. If the sewage continues to rise with the 500 g.p.m. pump operating, the 700 g.p.m. pump comes on and the 500 g.p.m. is thrown out of service. If, after the 700 g.p.m. pump is in service, the sewage level continues to rise, first the 300 and then the 500 are started. It will be noted by this sequence of operation that the maximum change in flow which occurs at any one time at the plant is at the rate of 300 g.p.m. All motors and control equipment at this pump station are approximately 3 feet above the maximum flood level record at this point. The pumps are connected to the motors with extended vertical shafts.

Control Chamber

The pump line from the pump station discharges into a reinforced concrete control chamber at the plant. In this control chamber there is a triangular notched weir to which is connected an indicating, recording and totalizing weir meter. In the control chamber the tannery waste is added to the domestic sewage. There are also a chemical line (ferrous sulphate) and chlorine line from the head house, a line from the pH adjusting acid tank, and the sludge discharge from the secondary settling basin, all of which discharge into the control chamber. This plant is designed for continuous operation with a minimum flow of 300 g.p.m. There is located in the control chamber a float control which starts a 300 g.p.m. return pump, drawing from the bottom of the secondary settling basin, whenever the flow to the control chamber drops below 300 gallons per minute. This discharge line enters the control chamber beyond the weir and is therefore not measured with the domestic sewage entering the plant. The flow from the control chamber is regulated by two sluice gates so that it may be allowed to go direct to the primary settling basin or to the slow mix chamber.

Slow Mix

Beyond the control chamber a slow mix basin is provided for the proper contact mixing of the domestic sewage with the tannery waste, acid and other chemicals. This slow mix basin has a detention time of 15 minutes based upon the average maximum flow, and is constructed of reinforced concrete. The equipment in this basin consists of two rows of two paddles each, the shafts of which are parallel to the direction of flow through the basin. These paddles are driven by a gear reduction motor. The discharge from the slow mix basin is carried through a 20-inch line to the primary settling basin.

Primary Settling Basin

The primary settling basin is of the circular center-feed type, 55 feet 0 inches in diameter, and is constructed of reinforced concrete, having a detention period of two hours based on the combined maximum average flow of domestic sewage and tannery waste. The water depth of this basin is only 6 feet. The influent line of the basin enters at the center and the effluent is drawn off from a notched weir around the perimeter of the basin. The basin is equipped with continuous sludge removal equipment. The effluent from the primary is carried by gravity to the rotary distributor on the trickling filter. The primary sludge is pumped to the sludge digester.

Trickling Filters

There are two trickling filters having a diameter of 130 feet and a depth of filter material of 8 feet. They were designed for BOD reduction of 540 pounds per day per acre foot, or an equivalent population per acre foot of 3,200. The filter media in these beds is crushed limestone which is required to meet the following specifications for gradation:

Passing 3-inch square laboratory screen, 100 per cent.

Passing 2-inch square laboratory screen, 50 to 70 per cent.

Passing 1¼-inch square laboratory screen, 10 per cent.

Passing ¾-inch square laboratory screen, 5 per cent.

The distributors for the trickling filters are of the rotary, impulse operated type having four arms. In order to provide for minimum flows, two arms on each distributor are controlled by weir plate in such a manner that they go into operation only after the capacity of the other two arms is exceeded. The structures for trickling filters are constructed of reinforced concrete with tile under drain system and an outer wall which gives a 3-foot space between the filter wall proper and the outer wall of the filter. This space forms an inspection gallery and permits inspection or cleaning of the tile ducts under the filter and also makes flooding of the filter possible if this should be found necessary for the control of filter flies. The discharge from the trickling filter flows by gravity to the secondary settling basin.

Secondary Settling

The secondary settling basin is of the circular type, 40 feet 0 inch in diameter, and provides for a detention time of one hour based on average maximum flow. This basin is constructed of reinforced concrete and provided with continuous sludge removal equipment. The incoming flow is introduced at the center with a down flow baffle, the effluent being collected by a notched weir plate at the perimeter of the basin. Since the top of this basin is below the flood levels previously experienced in this area, the motor driving the sludge removal equipment and also the motor driving the vertical non-clog type sludge pump were placed on an elevated platform 7½ feet above the top of the basin, which is above maximum previous flood levels—see photograph. *Before* entering the secondary basin the effluent from the trickling filter is treated with chlorine at a manhole provided for this purpose. The effluent from the secondary flows by gravity to the canal at a point downstream from the plant site.

Digester

The digester is constructed of reinforced concrete with a brick insulating wall on the outside. The digester is of the floating cover type and is circular in plan. This structure is 45 feet inside diameter with a theoretical height of 19 feet and a free board of 1.5 feet, making a total depth of 20.5 feet. The digester was designed on the following assumptions:

Total suspended solids in the combined sewage, 3,550 pounds per day; plant removal of solids, 85 per cent; all sludge to the digester from the primary clarifiers having a moisture content, 95 per cent; average volatile solids of raw sludge, 60 per cent; reduction of volatile solids on 30 day digestion period, 50 per cent. Therefore, the reduction in total solids in the digestion process equals 30 per cent. Digested sludge at 30 days, 93 per cent moisture. Sludge after ten day's storage, 92 per cent moisture and no further reduction in water for additional storage.

The digester is provided with four sample lines in order that sludge may be sampled from different depths in the digester. Arrangements permit return of the supernatant from various levels in the digester to the control chamber. The gas produced by the digester is used for heating the head house and the digester. Sludge from the digester flows by gravity to sludge drying beds.

Sludge Beds

The sludge drying beds are constructed with reinforced concrete walls. An underdrainage system of 4 inch farm tile laterals and 6-inch main collectors, with crushed limestone of approximately 9-inch depth covered with 6-inch of coarse sand, is provided. These beds were designed on the basis of one square foot per capita for an equivalent population of 15,500. Drying beds are divided into six sections in order to provide ample flexibility for the drawing, drying and removal of sludge.

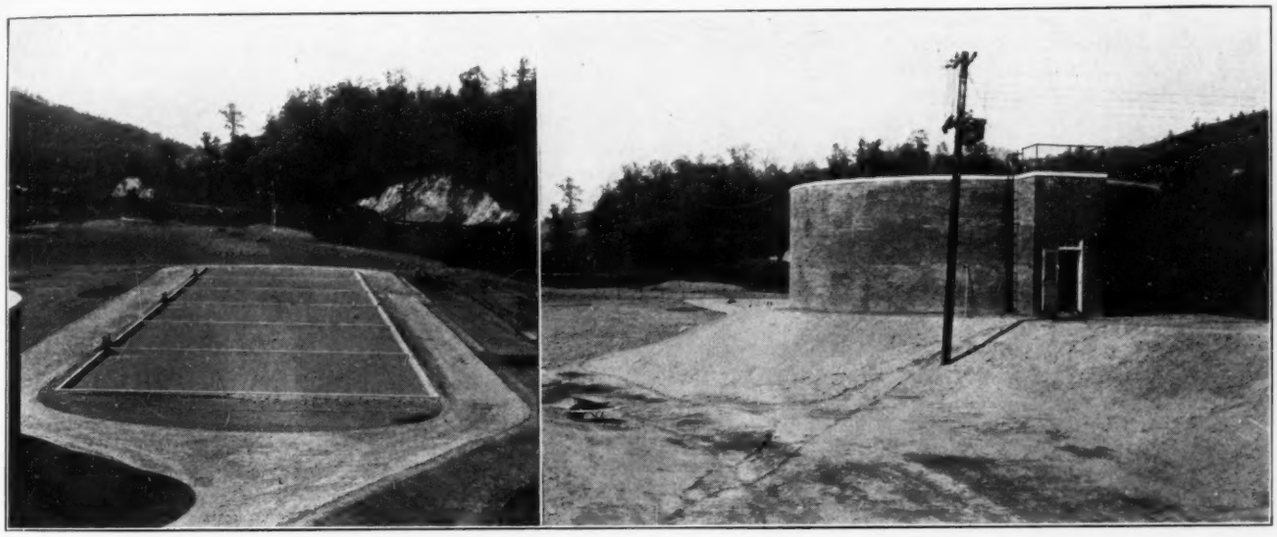
Tannery Waste Tank

The tannery waste collecting and storage tank is a cylindrical wooden tank, constructed of tank grade tidewater cypress, the staves being 3 inches in thickness and the bottom of the tank 4 inches. This tank is 30 feet 6 inches inside diameter, has a capacity of 104,000 gallons, and is supported on creosoted wood bents at such an elevation that a gravity flow is obtained from the tank to the control chamber. There is a flow control box on the line to the control chamber. It is equipped with an automatic level control valve to provide flow of the waste from the control box to the control chamber at a constant head and rate of flow.

Since the total waste from the tannery each day is discharged in a period of less than eight hours and since some of this waste is an acid waste and some an alkaline waste, the storage tank for the tannery waste was provided so that the waste entering the treatment plant would be more uniform in character and the treatment of this waste could be distributed over the entire twenty-four hours or any other period proving most desirable. This permits a greater dilution with domestic sewage than would be obtained were it pumped directly to the control chamber. Since the tannery waste contains a large per cent of suspended solids, including some free lime, it was determined that provision for agitation in this tank was necessary. Therefore, a paddle, near the bottom of the tank, is driven by a vertical gear reduction motor located on a structural steel walkway at the top of the tank.

Acid Tank

The acid tank is a standard steel tank of 8,000 gallons' capacity which rests in a horizontal position in concrete cradles near the control chamber. This tank was provided in order that acid employed for reducing the pH of the tannery waste could be purchased in carload lots and stored. It was decided that provision for acid treatment of the tannery waste was necessary as the test of tannery waste showed the pH to be above 11, and it was evident that we could not hope to obtain satisfactory plant performance if forced to handle a waste with so high a pH. The concentrated sulphuric acid, used for the reduction of pH, is fed from the tank through a lead lined constant head orifice box to the control chamber. As the tannery waste is fed at a constant rate it is very simple to adjust the rate of feed of the acid to obtain a satisfactory pH for satisfactory plant operation and maximum chemical economy when chemical precipitation is employed.



Brick Veneered Digester, with Floating Cover, and Sludge Beds on Left.
For flexibility of service the sludge bed was divided into six sections, provided with carefully designed beds and underdrains.

Head House

The head house consists of a two story brick and reinforced concrete building. This building houses all of the electrical control equipment at the plant, the main sludge pump, the standby sludge pump, the weir meter, the heating boiler, laboratory, chemical feeder, and toilet for the operator. It also provides ample space for the storage of chemicals. The sludge pumps, those serving the primary and secondary basins, are controlled by an automatic program time switch. This arrangement permits the withdrawing of sludge at intervals found most desirable, based on operating experiences, and for periods which are determined to be sufficient to keep the sludge from remaining too long in these basins. There is also located in the head house a dry feed machine for feeding ferrous sulphate and a manually controlled visible vacuum type chlorinator having a maximum capacity of 150 pounds of chlorine per twenty-four hours. This chlorinator is equipped with a split feed which permits the introduction of the chlorine either to the incoming sewage, the effluent from the trickling filters, or both, as may be found desirable. The chlorine lines are flanged steel pipe lined with hard rubber.

Financing

The sewer system and sewage treatment plant were financed by means of a loan and grant by the Public Works Administration. The amount of the grant was $191,454.30, and the loan, in the form of Revenue Bonds, which were taken by the Government with a 4 per cent interest rate, was in the amount of $233,999.70, making a total loan and grant of $425,454. These Revenue Bonds are to be paid, both as to principal and interest, from revenue derived from the tannery and from sewer rentals, as has been set out by special ordinance in connection with this work.

Construction

The contract for the construction of the sewage treatment plant was awarded to the Central Contracting Company of Dallas, Texas, on June 2, 1939, in the amount of $140,965. The final cost of this plant, including all extras, was $144,602.47. The construction of this plant was started on June 22, 1939, and was accepted on July 24, 1940. Contracts for the sewer system were awarded to G. M. Ferris, contractor of Athens, Tennessee, and to the Smith-Pew Construction Company of Atlanta, Georgia. The cost of that portion of the collecting system constructed by G. M. Ferris was $44,207.17 and the cost of the portion constructed by Smith-Pew Construction Company was $193,798.15. The sewer system was completed and accepted by the city of Middlesborough on July 2, 1940.

The sewer system and treatment plant were designed and constructed under the supervision of the organization of J. Stephen Watkins, Consulting Engineer of Lexington, Kentucky. The writer was in charge of design; the chemical treatment and equipment for same was planned by Mr. Frank U. Neat, Chemical Engineer for this organization; the construction work was under the direct supervision of Mr. Robert E. Martin, Resident Engineer on the project. The Federal Government was represented on this project by Mr. A. D. Zehnder, Resident Engineer Inspector.

Equipment

The major items of equipment in the treatment plant were furnished by the following companies:

Pumps and Comminutor—Chicago Pump Company of Chicago, Illinois.

Slow Mix Equipment—Chain Belt Company of Milwaukee, Wisconsin.

Primary and Secondary Sludge Removal Equipment—The Dorr Company of New York City.

Rotary Distributors, Dry Feed Machine and Tannery Waste Agitator—International Filter Company of Chicago, Illinois.

Floating Cover, Waste Gas Burner and Gas Control Equipment—Pacific Flush Tank Company of Chicago, Illinois.

Chlorinator—Wallace & Tiernan Company of Newark, N. J.

Conclusion

A complete collecting system and adequate treatment plant facilities have been provided for this community. It will require some time to complete all the connections to the system. However, with proper enforcement of the city ordinance requiring connections to the system and proper operation of the plant, the people of this community should now enjoy greatly improved sanitary conditions.

HOW BLACK LINE PRINTS ARE MADE FROM BLUEPRINTS*

I find that many men are not informed regarding the least costly way in which to reproduce blue prints for making engravings. The usual method is to do the entire drawing over, in black ink on white paper, which is usually expensive—so expensive, in fact, that it too often isn't done at all.

I have reproduced many blueprints frequently without doing a single line of inking. My method is to send the blue-print to a photostat concern and specify the size I want. The minimum size of photostat is 8½x11 in. and costs only 25 cents. The photostat copy which they return to me, together with my original blue-print, is a so-called "positive." That is, the lines are black and the background is white. A first class photostat job will give good sharp black lines which can be reproduced without difficulty.*

*Contributed by W. F. Schaphorst, Newark, N. J.

"SEWER RENTALS"
Now in Third Printing by A.P.W.A.

The American Public Works Association has recently made the following announcement in the January issue of its monthly "News Letter":

A nation-wide interest in methods of financing sewage disposal, resulting in an enthusiastic and continuous demand for the Association's Bulletin No. 7, "Sewer Rentals," has exhausted the second printing and the third printing, with revisions, is being run. In order that the study could be brought up to date, the Association revised the text and tables and added the practices of twelve cities throughout the country, including all of the larger cities, which have adopted sewer rentals since the bulletin was first published.

Sewer rental practices in the following cities have been added: Tallahassee, Fla.; Bloomington, Ind.; Cedar Rapids, Fort Dodge, and Iowa City, Iowa; Battle Creek, Detroit, and Jackson, Mich.; Minneapolis and St. Paul, Minn.; Buffalo, N. Y.; and Portland, Ore.

In order that members of the Association can bring the tabulated information in their copy of the original edition of "Sewer Rentals" up to date, a supplement consisting of 14 pages of tables, presenting the additional data, has been prepared and is available to them upon request; to non-members at 15c per copy.

The price of the revised 128-page bulletin is $1.50 a copy. A.P.W.A. members are entitled to a 20 per cent discount. Copies may be ordered from Association Headquarters at 1313 East 60th St., Chicago.

WATER AND SEWAGE PATENTS

Reported by JULIAN F. SMITH
ASSOCIATE DIRECTOR
Hooker Scientific Library, Center College
FAYETTE, MO.

This is the beginning of a new service to readers of WATER WORKS AND SEWERAGE, *many of which are interested in patents issued which pertain to some phase of water supply, water treatment, sewerage and sewage disposal.*

It is proposed to print these patent abstracts from time to time, as the number becoming available justifies. For the present such is proposed for issues of alternate months.

Not all patents issued in the water and sewage field will be reported; however, all those which would seem to be of most interest will be.

We are indebted to Professor Smith, who maintains a record of patents for the Hooker Scientific Library, for agreeing to supply us with records of water and sewage patents.

Water Patents

Freeing Water from Fluorine. A. S. Behrman and H. B. Gustafson (to International Filter Co.). U. S. 2,227,432, Jan. 7. Treating water with tricalcium (or trimagnesium) phosphate to remove fluorine compounds, and regenerating the spent phosphate with aqueous alkali, followed by treatment with carbon dioxide.

Softening Water. H. L. Tiger (to Permutit Co.). U. S. 2,227,520, Jan 7. Softening water by passing it through a bed of high capacity granular carbonaceous zeolite, and regenerating the spent zeolite by contact with water and carbon dioxide or sulphur dioxide.

Centrifugal Pump. A. G. Forssell (to Morris Machine Works). U. S. 2,228,207, Jan. 7. The casing of a centrifugal pump has a horizontal front inlet and a tangential peripheral outlet, while the impeller has a rear shroud and a larger front shroud.

Reagent Feed. G. M. Booth (to Wallace and Tiernan Co., Inc.). U. S. 2,229,038, Jan. 21. A device for feeding a liquid treating reagent to raw water has a pumping chamber and a balancing chamber, with a pumping diaphragm between, and a feed pipe leading from the diaphragm.

Washing Sand Filters. N. J. Kayser (to Filtration Equipment Corp.). U. S. 2,229,894, Jan. 28. A traveling cleaner has a caisson which moves over successive portions of a sand filter bed for washing the sand by hydraulic and air action.

Water Tank. J. S. Eastman (to T. W. Snow Construction Co.). U. S. 2,230,239, Feb. 4. A water tank subject to freezing weather has a vertical pipe extending above the water level and containing a water column on which floats a non-freezing vapor-sealing liquid carrying a float which closes a valve as it rises or opens the valve as it falls.

Deep Well Pump. H. M. Loeber (to Dempster Mill Mfg. Co.). U. S. 2,231,131, Feb. 11. A reciprocating pump rod mechanism utilizing a rock lever connected by an eccentric to the shaft in the pump housing.

Cleaning Water Mains. Lon D. Wright. U. S. 2,232,018, Feb. 18. A safety device for air turbine rotary cleaners used in water mains comprising a check valve adjacent to the turbine and discharge ports in the motor, serving to retain air in the motor when it is not in operation.

Water Purification. Richard D. Moore. U. S. 2,233,218, Feb. 25. Segregating horizontal columns in a body of water to be treated, adding a purifying chemical near the front of the column, allowing the water and chemical to react from front to rear of the column at a rate not permitting sedimentation, discharging the column of treated water to a settling basin and finally returning the treated water to the original body of water.

Cation Exchange. H. Wassenegger, R. Griessbach and W. Sutterlin (to I. G. Farbenindustrie Aktiengesellschaft). U. S. 2,228,159 and 2,228,160, Jan. 7. Making a base-exchanging resin by condensing a phenol with formaldehyde in presence of sodium sulphite; and using the product for base exchange in water purification.

Ion Exchange. D. M. Findlay (to U. S. Rubber Co.). U. S. 2,230,641, Feb. 4. Purifying water with the aid of an insoluble resin made by condensing a monohydric phenosulphonic acid with formaldehyde.

Sewage Patents

Sewage Disposal. G. J. Strezynski (to De Laval Separator Co.). U. S. 2,227,851, Jan. 7. Accelerating bacterial growth in sewage, after preliminary sedimentation, settling and removing residual solids and bacterial growth as a secondary sludge which is centrifuged for final separation of solids from the liquid.

Concentrating Sludge. J. S. Pecker (to American Centrifugal Corp.). U. S. 2,228,017, Jan. 7. Continuously settling solids from incoming raw sewage in stages to yield sludges differing in moisture content, combining and partially concentrating the sludges and then centrifuging.

Sludge Treatment. J. S. Pecker (to American Centrifugal Corp.). U. S. 2,230,835 and 2,230,836, Feb. 4. Centrifuging thickened sewage sludge, then aerating, degreasing and filtering the liquid fraction; and treating sewage in a gravity sedimentation apparatus having upwardly inclined baffles around the walls and on the center shaft to provide a circular flow path.

Sewerage Treatment. O. M. Urbain and Wm. R. Stemen (to Charles H. Lewis). U. S. 2,232,294, Feb. 18. Removing organic impurities from liquids by adding a magnetic powder and precipitating the powder with a magnetic field so that organic contaminating materials are entrained with the precipitate and so removed from the liquid.

Sewerage Treatment. O. M. Urbain and Wm. R. Stemen (to Charles H. Lewis). U. S. 2,231,295, Feb. 18. In the magnetic precipitation method of removing organic impurities from a liquid, use of magnetic powder as the precipitating medium.

Sewerage Treatment. O. M. Urbain and Wm. R. Stemen (to Charles H. Lewis). U. S. 2,232,296, Feb. 18. In the magnetic precipitation method of removing organic impurities from a liquid, use of chlorinated natural magnetite as the precipitating medium.

CLEVELAND MAKES SEWAGE TREATMENT HISTORY

(But of a Rather Bad Order)
New Plants Ordered Shut Down When Council Fails to Provide Funds

LAST month the three Sewage Treatment Plants of Cleveland, Ohio, were shut down as the result of a lack of funds with which to pay operating costs. This action by a major city created front page news which spread rapidly over the country and proved no credit to Cleveland's governing body or the local administration. Sewage treatment history was made in Cleveland during February when sewage was bypassed around costly idle plants into the city's source of water supply at the most hazardous period of the year. It was history of a bad order; for, as far as we are aware, the bypassed sewage was not even chlorinated, creating a hazard of some consequence to the safety of Cleveland's water supply.

The plants were ordered shut down by the Director of Public Utilities, J. A. Hickey, acting under instructions of the Mayor. The reason for such action was that the Common Council of Cleveland had by its actions failed to provide a source of funds with which to meet plant operating charges and pay employees' wages. What happened was the culmination of a long fought over question of where funds should come from to pay sewage disposal costs. The scrap started while two-fisted Frank Wallene was Cleveland's Director of Public Utilities, and was in the end one important cause of his resignation.

The battle in Cleveland's unwieldly (if not unruly) Council came to a final conclusion with the 18 to 14 vote on February 18th, which defeated the proposed Sewer Rental Ordinance, designed to supply funds for maintenance and operation of the sewerage system and treatment plants. The rental scheme was set up on the basis of payments proportionate to service rendered—i.e., on the basis of metered water consumption or metered wastes discharged into the sewers. On all water bills a flat surcharge of 22 cents per 1,000 cu. ft. was to be added as the Sewerage Service Charge. Councilmen voting against this modern business-like method of financing sewage treatment explained their actions on the grounds that they considered the rate too high and that they favored financing by further taxation of real estate. Assumedly the funds were to come from the General Tax Fund, although Cleveland's citizens had already voted down the proposal to finance sewage disposal via the route of increased taxation, rather than a charge based on service rendered the payer—a very healthy sign and encouraging to those who see the Sewer Service charge as the only business-like and equitable method of paying for sewage treatment.

As the outcome of Council's action, and subsequent plant shut-down on February 21st, a Court edict was forthcoming without much delay. It ordered *immediate* resumption of complete sewage treatment operations. Judge Frank S. Day (Court of Common Pleas) in commenting on failure of Council to provide operating funds considered this "an act of stupidity hard to find paralleled in the annals of any legislative body." He was caustic in his admonition of the Mayor and the Director of Utilities for permitting the shut-down, regardless of Council's action, as "next to callous disregard for the health and safety of the community." (Here we must say in Director Hickey's behalf that he was in a tough spot, and was to be damned no matter which of the two possible actions he should have taken. Council had already been warned by the Mayor that voting down the Sewer Rental Ordinance, without providing funds from another source, would necessarily mean that the plants would be shut down.—Ed.)

Plants Returned to Operation

As the outcome of the order of the Court and pressure brought by State and City Health Departments, the plants have been returned to service but not without added costs caused by damage to certain units of the plants for which freezing weather was responsible—not to mention the loss which comes to the activated sludge process when a plant is shut down for periods of consequence.

On advice by Judge Day to the Mayor and the Council, the Sewage Rental Ordinance has in the meantime been reconsidered and was favorably voted on February 24th, at a compromise rate of 18 cents per 1,000 cu. ft. as the temporary service charge to be considered effective March 1st and to hold through the balance of 1941.

With the wish in mind to present an accurate and inclusive story of Cleveland sewage disposal financing problems and what led up to the rather phenomenal acts of last month, which brought Court admonition to all concerned, we have prevailed upon Mr. J. W. Ellms, Cleveland's Commissioner of Sewage Disposal who has lived through all of the controversy, to give us the facts. This he has done without comment and we reproduce his statement on opposite page.

NEW ENGLAND WATER AND SEWAGE ASS'NS. TO MEET JOINTLY APR. 3RD

In conjunction with the 11th New England Health Institute to be held at Hotel Statler in Boston April 2-3-4, the New England Water Works Association and the New England Sewage Works Association have planned a joint meeting of these two groups on the second day, Thursday, April 3rd.

The two joint sessions, under the special chairman, Arthur D. Weston, Chief Engineer, Mass. Dept. of Public Health, will feature "Environmental Sanitation — Water Supply and Sewerage—in National Defense," in line with the general theme for the entire three-day meeting—"Public Health in National Defense."

Topics listed on the program include: "The Emergency Protection of Water and Sewage Works"; "Sanitary Problems in the Vicinity of Troop Areas"; "Military Field Sanitation"; "Development of Water Supply and Sewerage for Cantonments and Camps"; "The Possibilities of Water Supply Infection or Poisoning."

A joint luncheon is scheduled for mid-day and on the same evening the Dinner Dance is scheduled.

THE CLEVELAND SITUATION

Some Facts Pertaining to Financing Sewage Disposal

By J. W. ELLMS

THE history of sewage treatment plant operation and maintenance in Cleveland dates back to the year 1923. During the preceding year, this city had completed what is known as its Westerly Sewage Disposal Plant. This was the first plant constructed under the supervision of the Department of Public Service. In 1928 the City completed a second plant, known as the Southerly Sewage Disposal Plant. In 1938, the third, or Easterly Sewage Disposal Plant, was completed. The Southerly plant and the Easterly plant were designed by outside consulting engineers, and the construction work was done in the Southerly plant under the supervision of the Department of Public Service, but the construction of the Easterly plant and the necessary equipment for this plant, which was located at the Southerly plant site, was done under the general supervision of the Department of Public Utilities.

J. W. Ellms

The general development of sewage treatment has been undertaken by the City of Cleveland and at the City's expense. The growth of the suburban villages and cities around Cleveland has created a suburban problem, for the supply of water and the disposal of sewage, which have become a part of the services required for a metropolitan district. The City has recognized this problem and has provided in its sewerage system and disposal plants for rendering these services. However, this was done without specific authorization by the suburban communities.

As early as 1903, one of the suburban communities made arrangements with the City, whereby their sewered system was connected into the City's system. The cost of the outlet privileges was merely nominal, but, nevertheless, remained in effect up to the present time. Other communities have since made agreements with the City. Most of these agreements provided for payments for sewerage connections and treatment on a per capita charge, based on operating cost, plus capital reduction charges. In only two of the suburban cities has this old type of agreements been superseded by contracts based on a water use base per 1,000 cubic feet. There are other communities which have their own sewage disposal plants which treat their own sewage, and in one case, a reciprocal agreement has been in force by which this particular community treats some of the City's sewage, and the City treats some of this suburban community's sewage. In other cases, for certain rights for building interceptors or the location of disposal plant sites, no charges have been possible for the use of the City's system.

Division of Sewage Disposal Established

In 1923, the operation of the then existing sewage treatment plant of Cleveland was placed in the Division of Water and Heat of the Department of Public Utilities. This Division of Water thereafter furnished the money for the operation and maintenance of the plants, and continued to do so until a taxpayer's suit was brought in January, 1930, which prohibited the City from using waterworks funds (The Hartwig Realty Company vs. City of Cleveland, et al., Common Pleas No. 382301, affirmed by Supreme Court Case No. 24764, November 14, 1934). Following this decision, revenue was obtained from the General Fund until July 17, 1938. The enlarged plants obviously required considerably more revenue than had been furnished by the Division of Water or was obtained from the General Fund. In fact, a Division of Sewage Disposal was not created until July 15, 1935, which Division was to be operated in the Department of Public Utilities, although the revenue was derived from the General Fund. On October 16, 1937, a position of Commissioner was created to administer this Division.

Sewer Service Charge Established; but Short-Lived

On July 17, 1938, the City Council passed an ordinance for providing revenue for the operation and maintenance of the Division of Sewage Disposal by charging a percentage of the water bill. The charge was first made 40 per cent of the water bill and continued so until October 18, 1939, at which time the Council reduced the rate to 25 per cent of the water bill. This rate continued in effect until an ordinance repealing this method of raising revenue was passed on January 17, 1940. During the year 1940, about $240,000 was obtained from the General Fund for operating the plants. Other revenue was derived from Accounts Receivable, due from the charges under the original ordinance. Old agreements were cancelled with some of the suburban communities and the settlements then made became available for operating the plants. However, by the fall of 1940, it was apparent that there would be insufficient revenue to pay for the administration, operation and maintenance of the Division. New agreements with two of the larger suburban communities provided some funds immediately for use, but obviously since less than 12 per cent of the revenue needed for the Division came from the suburban communities, it was quite insufficient to continue operation. Every effort was made to secure money owed on existing suburban agreements, both from the independent incorporated villages and cities, as well as from the county—i.e., from what is known under the Ohio state law as "County Sanitary Districts." In consequence, lack of funds delayed the payment of employees and almost a complete stoppage of the payment of contractors and vendors for supplies and services.

Electorate Favors the Service Charge—Council Says No

The opposition to the water use base for sewerage service charges came largely from the owners of small homes, who declared that this cost should be paid out of the General Fund. At two different times, during the past year or year and a half, this question of how the revenue should be raised was placed on ballots in order that the electorate might express an opinion. Twice the electors voted for the water use rate base. In the last election, the majority favoring the service charge was practically in the ratio of two to one. Nevertheless, the opponents of this method have maintained a continuous campaign against it and are threatening to again bring it to the attention of the voters. In this con-

nection, the difficulties which the administration has experienced in reaching agreements with the suburban communities appear to have increased the opposition of the Cleveland City Council to providing any revenue for the operation of the Division of Sewage Disposal.

In 1939, the City employed three well known engineers to report upon this problem. After extended analysis of such costs of operation as were then available, and considering all possible sources of revenue, they recommended the water use rate as a base, and a charge of 22c per 1,000 cubic feet of water. For suburban communities outside the City limits, the fixed charges were added to the operation and maintenance charges and varied according to the particular community involved, from 18c to 24c additional to the 22c. These engineers further recommended that all fixed charges for the City be derived from general taxation.

Council's Latest Action And Reconsideration

An ordinance, submitted to the City Council during the month of December, 1940, provided for this 22c per 1,000 cubic feet to be charged to the citizens of Cleveland. It was defeated in Council on February 18th, 1941. Following its defeat, which resulted in shutting down of sewage treatment, it was reconsidered. It was amended to make the rate for the City 18 cents per 1,000 cubic feet, and to remain effective until December 31, 1941, and was passed on February 24, 1941. The new sewer service charge went into effect March 1, 1941. The revenue which this rate will provide, together with Accounts Receivable, and revenue from new agreements which may be executed with the suburban communities not now under contract, become the sources of revenue to operate the Division of Sewage Disposal for the year 1941.

From February 18, or the day following the defeat of the 22c rate ordinance, until February 25th, the date following the reconsideration and passage of the amended ordinance, the three treatment plants of Cleveland were practically shut down and raw sewage was discharged into the Cuyahoga River and to the lake. They are again in partial operation, but at the Easterly activated sludge plant, it will be several weeks yet before the biological processes can again be effectively established.

NATIONAL DEFENSE NECESSITATES NEW WATER AND SEWERAGE FACILITIES

$104,000,000 Recommended Expenditure

WASHINGTON.—A considerable expansion in water supply and sewerage facilities, to take care of population increases in many defense communities, has been proposed to the House Committee on Public Buildings and Grounds by Charles P. Taft, assistant coordinator of health and welfare, Office of Production Management. He recommended that any considerable increase in existing facilities or installation of new facilities be financed, in most instances, by the Federal Government, in part or in whole. The estimated requirement for such projects runs to $104,000,000 as the proposed expenditure.

Mr. Taft appeared before the committee on March 4 during consideration of the pending Community Facilities Bill, which provides for an appropriation of $150,000,000 for "community facilities in those communities where there exists or impends such an acute shortage of such facilities as to impede essential national defense activities."

Estimated cost of facilities, whose construction eventually will be necessary, was placed by Mr. Taft at $27,000,000 for water supply, $24,000,000 for sewers, and $53,000,000 for sewage treatment. Sewage treatment, he told the committee, has been considered only where the increase in amount of sewage will produce obnoxious conditions in the receiving body of water or will have a deleterious effect on water supplies taken from such body of water.

Estimates of amounts needed for the first year included $15,000,000 for water supply, $12,000,000 for sewers, $22,000,000 for sewage treatment, or a total outlay of $49,000,000 during the first year.

"Many defense communities are without public water and sewerage facilities and where existent seldom exceed the normal requirements," Mr. Taft testified. "In order to serve the increase of populations expected in these areas the present facilities must be greatly expanded or in many instances complete new facilities must be provided.

"It is believed that any considerable increase in existing facilities or installations of new facilities should, in most instances, be financed and constructed by the Federal government. Reimbursement where claimed should be derived from operating revenues. Grants, as such, are not recommended, although in many cases the financial outlay by the Federal government will in effect be a grant, since the facilities may not be necessary after the termination of the present emergency.

"Where existing facilities of an established community are increased only slightly, this may be done through a loan and the operation can be undertaken by the municipality or district owning such existing facilities, without further outlay or responsibility by the Federal government.

"New installations may require operation by the Federal government until the emergency has passed or the community has become a legal entity and can take over the operation. Revenues from any individual installation should be available for its maintenance and operation as is the usual procedures with self-sustaining facilities.

"It is probable that where facilities are greatly increased, or newly installed, some financial assistance from the Federal government toward maintenance and operation will be necessary for a short period of time. Out of a 1,500,000 estimated increase in population in the areas under consideration, 1,125,000 will require water supply and sewerage services."

James G. Ellis,
Washington Correspondent.

REBABBITTING BEARINGS

Inasmuch as most large concerns are now equipped with welding outfits the writer wishes to point out that such outfits can be used to advantage in renewing babbitted bearings.

Instead of removing all of the old babbitt, melting, making a mandrel, placing, pouring, cutting oil grooves, etc., the better and more modern method is simply to remove the shaft or the bearing and then build up the babbitt with the welder until the proper thickness is attained. Do not fill up the oil ring grooves or the oil holes.

Bearings can generally be completed in a much shorter time than is possible by the old method and the final cutting operation or "machining" requires practically no time at all. There is no possibility that the bearing will warp out of shape because of overheating or internal heat stresses. Surely this is a method worth knowing about.

*Contributed by W. F. Schaphorst, M.E., Newark, N. J.

N.E.W.W.A.

Passes a Resolution Concerning Water Supply and Priorities; Hears the Complete Story of the Rochester Accident

IN SHARP contrast with the 1940 February meeting of the New England Water Works Association, which constituted a record in low attendance at N.E.W.W.A meetings (the total number present being 13 active members and 13 "Ambassadors of Commerce," the result of a New England blizzard that almost stopped New England) the February 1941 meeting proved one of the best attended, the registration count being 230.

Leland G. Carlton
Supt. of Water
Springfield, Mass.
(The President)

Horace J. Cook
Supt. of Water
Auburn, Maine
(Round Table Leader)

A Resolution and a Reply:

The following resolution was offered by Henry T. Gidley and unanimously passed as the result of actions taken by the Director of Priorities in the Office of Production Management, at Washington, in refusing to establish blanket priority for water works utilities placing orders for materials and equipment, such as may constitute emergency needs in some instances.

Be It Resolved—

"That the New England Water Works Association go on record as favoring that as the water supply is a vital and fundamental part of the community that orders for supplies for emergency repairs be given equal priority with all defense orders. That a copy of this Resolution be sent to Edward R. Stettinius, Director, Division of Priorities, Office of Production Management, Washington, D. C."

This resolution has now been replied to in a letter from the Director of Priorities. It is to be noted that water works managers are told that each case must be considered on its own merits. While there is little therein to encourage water works managers to be lax in the matter of getting ready in advance for possible emergency needs, there is assurance at least that a real emergency will bring the special priority order from the Director of Priorities if such be needed. His letter follows:

OFFICE OF PRODUCTION MANAGEMENT
WASHINGTON, D. C.

February 28, 1941.

Mr. Frank J. Gifford, Secretary
New England Water Works Assn.
613 Statler Building
Boston, Massachusetts.

Dear Mr. Gifford:

We thank you very much for sending me a copy of the resolution adopted at a meeting of the New England Water Works Association on February 20.

We are glad to have this information and wish to assure you that any specific requests arising from unforeseen circumstances will be given our careful attention.

Sincerely yours,
E. R. STETTINIUS, JR.
Director of Priorities.

Water Hammer Is School Topic

The winter meetings of N.E.W.W.A. have for the past 3 years opened with a session of the Water Works School in which a valuable series of lectures on Hydraulics has been given by Professor George Russell of the Massachusetts Institute of Technology and in an interest holding manner of high compliment to the Professor.

In handling the topic "Pipe Line Surge and Water Hammer," Professor Russell did a splendid job of explaining the "why and how" of surge and developing formulae for calculating the speed of pressure wave travel, and the pressures which may be anticipated from water-hammer resulting from surge in pipe lines of various lengths, sizes and materials, due to sudden stoppage of flow.

All who have attempted to follow such explanations of pipe lines surge, the travel of the pressure wave, and resulting water hammer, will realize that no effective explanation can be given in such a report as this one. In fact, the picture of what transpires and the results are difficult to present in any written text, whereas the good Professor (in action) made the picture clearer than most explanations of the phenomena which have been heard by this writer.

Programmers

Richard H. Ellis, Engineer,
Assoc. Factory Mutual Ins. Cos., Boston
(A Past President of the Association)

F. H. Kingsbury, Sr. Asst. Engineer,
Mass. Dept. of Public Health, Boston
(Association's First Vice-President)

Earl Devendorf,
Assistant Director, Div. of Sanitation,
N. Y. State Dept. of Health, Albany

Amongst the various formulae developed in predicting the maximum surge head (hammer pressure) for various pipe lines, the following were arrived at:

(a) For Cast Iron Lines
$\triangle p = (44 \text{ to } 57) \times V$

(b) For Steel Lines
$\triangle p = (30 \text{ to } 55) \times V$

(c) For Asbestos-Cement Lines
$\triangle p = (25 \text{ to } 41) \times V$

In these short formulae for approximate values—

The Water Works School and P. M. Session

Professor Geo. E. Russell of Mass. Inst. of Technology in action developing water-hammer formulas during the morning water works school. In the center are some intent listeners to the afternoon papers. We recognize two past presidents—Percy Shaw and Theo. Bristol.

△ p = lbs./sq, in. maximum hammer pressure
V = flow velocity in ft./sec. at time of sudden valve closure.
(— to —) = Are derived factors for pipe sizes between 4 in. and 84 in. diameters. The lowest figures applies to 4 in. pipe and the highest to the 84 in. size.

He explained that the factors given for the various pipes are determined from the elasticity of the pipe material. In calculating these values for C.I. pipes, a modulus of elasticity of 12,000,000 lbs. was employed, whereas for the asbestos-cement pipe the value of 2,000,000 lbs. was assumed. In this manner the calculated maximum hammer pressure for a given exact set of conditions would prove to be in the order of 100 lbs. for C.I.; about 80 lbs. for steel, and approximately 72 lbs. for asbestos-cement pipe. Professor Russell was of the opinion that pipe lines having rubber gasketed joints would build up a lesser maximum pressure, because the pressure wave would be cushioned out in a measure by the many resilient joint rubbers, acting as shock absorbers.

He explained that these pressure-waves traveled at the phenomenal velocities of 3,000 to 4,500 ft./sec. and that the desired rate of closure of valves to most effectively preclude serious surge and hammer pressures must be calculated for every individual set of conditions. The most certain method of relieving surge was to provide ample relief valves, capable of quick opening and slow closure, thereafter, wasting whatever water might prove necessary in the functioning of such valves. However, a proper timing in valve closure was in most instances alleviating, if not wholly corrective of the hammer condition.

To his audience, Professor Russell recommended a publication of the American Society of Mechanical Engineers—"A Symposium on Water Hammer," as the best available treatise on the subject.

Superintendents' Round Table

(Chairman—Horace J. Cook, Supt.) Auburn Water District, Auburn Maine.

1st Topic—Methods of Collecting Water Bills.

In opening the discussion of this topic, Mr. Cook in reviewing Auburn, Me., practices, stated that the District was mostly on a flat rate basis, with a schedule of charges per fixture payable quarterly in advance. Four seasonable colors are used for the bills, for instance, golden-rod yellow for Fall, light green for Spring, etc. Charges for sewerage services are billed on a brown card all year. Thirty days are allowed in which to pay, at the end of which delinquent notices are sent and a warning of the shut-off for non-payment. Experience indicates that the first notice reduces the normally 20 per cent delinquencies to 3 per cent. The shut-off man collects all but 1 per cent. Mr. Cook pointed out the perseverance exhibited in collecting before a final shut-off order is issued sometimes 8 calls being made. However, the shut-off *is* enforced to a 100 per cent degree, with the result that at the end of each quarter the bills for the previous quarter have been 100 per cent paid. To this there were three exceptions in the past few years, wherein extreme poverty and ill luck had justified the District requesting permission (please note the permission) from the Public Utilities Commission to abate the bills of 3 consumers. However, for the most part people really unable to pay are permitted to work out their bills with the District.

Aces—"Supers" All
Arthur C. King
Taunton, Mass.
Roger W. Esty, Past President
Danvers, Mass.
Roger G. Oakman
Needham, Mass.

Mr. Cook exhibited his Auburn office record cards, and the scheme of employing transparent color tabs to show the history of the account at a glance. The way these tabs slide along the card, to reveal information at a quick glance, was extremely interesting, and is equally difficult to describe. He was high in his praise of the backing received from all of the Water Commissioners in the matter of enforcing the cut-off regulation to the last letter.

In reply to questions Mr. Cook said there was a $2.00 charge for the turn-on after a shut-off. There had been no difficulty with Health Authorities where a shut-off had been enforced. In Maine there is no lien law in regard to water bills.

Harold L. Brigham, Sup't. of Marlborough, Mass., stated that the lien law was employed there and no shut-off practiced in his town, all bills being collected from banks and mortgage holders, and there was no arrangement for delinquents working out their bills. The old scheme of requiring a deposit on meters had been discontinued.

A. F. McAlary, Sup't of Camden-Rockland Water Company, Rockland, Me., stated that they bill only every 6 months. Former practice of accepting partial payments had been discontinued, the scheme now being to accept a part payment only for holding in the consumer's name and no credit shown on the bill until the deposits had been sufficient to clear up the bill completely. He warned of the danger of accepting checks for payment in amounts greater than the value of the bill to be paid, because experience in the past had resulted in the consumer claiming, with the aid of cancelled checks, to have paid more than was actually the case. In connection with cut-off, he told of a scheme of secretly inserting a cork stopper in a union on the service line in order to prevent the delinquent from turning on the

(1) *Frank P. Hall, Supt. Water and Sewage, Athol, Mass.;* (2) *Otis S. Tolman, Supt. of Water, Sharon, Mass.;* (3) *Maurice A. Libby, Supt. of Water, Bath, Me.;* (4) *Wm. Johnson, Sales Manager, Phoenix Meter Co., N. Y. C.;* (5) *E. E. Lockridge, Chief Engr., and* (6) *D. F. Sweeney, Registrar, Water Dept., Springfield, Mass.;* (7) *William James Caird Marshall (otherwise "Scotty"), Supt. of Water, Georgetown, Mass.;* (8) *Jack Carey, Mathieson Alkali Works, Providence, R. I.*

water. Even this scheme has not been 100 per cent successful in stopping the delinquent from getting water. He said the policy of his company was that "The burden of service is the company's; the burden of payment, the customer's"—and, that they did not consider it their duty to make careful investigations in each case of delinquency.

Henry T. Gidley, Sup't., Fairhaven Water Co., Fairhaven, Mass., pointed out that there was no lien law benefit to private water companies. In consequence they have been accepting partial payment of bills and was happy to report that 98.5 per cent of all bills had been collected. He made the interesting comment that W.P.A. workers had been found to work good for the water company, and badly for the W.P.A. He told of an interesting case of having to collect rent from tenants for a considerable length of time, in one instance, to liquidate a long running bill of the tenement house owner. He didn't want to get into the rent collecting business again.

A. M. Symonds, Division Manager, Northeastern Water & Electric Co., Millbury, Mass., stated that his company with 60 plants in New England, has established a bogey-line which is not more than 5 per cent bills outstanding un-collected at any one time. He was pleased to note that 40 of these companies had records now above the line—that is, less than 5 per cent uncollected.

Michael E. Quirk, Sup't. Peabody, Mass., reported that a special collector had been recently appointed in his office, this man having been an outstanding meter reader. In attempting to collect delinquent accounts, no calls were made on the delinquent; but, instead, definite appointments were made in the office, which seemed to be a little bit more of a business-like practice than knocking at the back door, and, as a matter of fact, had been much more effective. Instead of a cut-off they had employed the little disc with a 64th inch orifice to fit in the service line, allowing the consumer to get at least some water. This practice had been the subject of interesting cartoons in the local newspaper, such cartoons being really very helpful in the matter of collecting for water service.

A member from Sudbury, Mass., (a water District), stated that shut-offs are practiced after 30 days' notice. In this connection the local Board of Health had ordered water turned back on properties, which the District refused to do, unless the Health Department pays the bill. Taking this matter to the State Department of Health, its ruling is that nothing can be done about it, other than the fact that the property may be condemned as a health menace until the bill is paid and the water turned on.

Horace L. Clark, Supt., Sanford Water Co., Sanford, Me. (Director of N.E.W.W.A.)
Michael E. Quirk, Supt., Water Dept., Peabody, Mass.
Alan A. Symonds, Division Manager, N.-Eastern Water & Elec., Millbury, Mass.

Roger Esty, Sup't. Danvers, Mass., said that he couldn't boast too highly concerning the status of his Department in regard to delinquent accounts, because at one time during the depression collections had gotten as much as 51 per cent behind. They had allowed delinquents in the poor class to work out bills. By persistency the unpaid accounts had been little by little reduced. He suggested that Mr. Sullivan tell what he had accomplished in the matter of collections in Boston.

Daniel M. Sullivan, Boston, then said that they did not employ the lien law in Boston, nor did they practice the "shut-off." However, they do practice "discontinuanec of service," which did not sound half so harsh. He reported that at one time a single apartment owner had owed the Water Department of Boston $3,000, and the surprising figure of $2,800,000 had represented the total unpaid water bills. By the "discontinuance of service" route this unpaid debt had now been reduced by 95 per cent. In regard to poor people they were not bothered until the bill amounts to more than $10.00. A successful argument with the small water user is that if he can afford to buy one newspaper a day he can more easily afford to pay the cost of water, which is less than that of the daily newspaper.

Arthur C. King, Sup't. of Taunton, Mass., who is Chairman of Legislative Committee of the Association, reported that he had just left a hearing by a Committee of the Legislature (Mass.) on a bill which if it had not been defeated, would have prevented water shut-offs or any reduction in pressures by any means because of non-payment of water bills. He reminded his listeners that the lien law in no way curtails the right to shut-off the service for non-payment.

(1) *Walter Arnold, Public Works Supply Co., Lynn, Mass.;* (2) *Allan F. McAlary, Supt., Camden-Rockland Water Co., Rockland, Me.;* (3) *Chas. J. Crump, Supt., Water District, Bourne, Mass.;* (4) *W. Guy Classon, Supt. of Water and Registrar, Leominster, Mass.;* (5) *Nelson Boardman, Asst. Supt. of Water, Danvers, Mass.;* (6) *E. J. Prescott, Flexible Sewer Rod Equip. Co., Auburn, Me.;* (7) *E. L. Jette, Supt., Salisbury Water Co., Salisbury, Mass.;* (8) *Mark F. Crocker, Supt. of Water, Newton, Mass.*

2nd Topic—Watershed Protection

Mr. Esty opened discussion of this topic by telling of Danvers experiences, in which they had purchased a 5 rod strip surrounding the reservoir, for absolute control, and were continually purchasing more watershed property, most of which had been cleared and reforrested with pines. He pointed out that the pine needles protected the ground, keeping the frost out and allowing the rain water to be absorbed, until now it had been noticed that a rain of a given intensity did not cause the reservoir to rise as it once did. He also pointed out that the pine needles did not stain the water as oak leaves do, and that evaporation from needles was only about one-eighth of that exhibited by leafy trees.

Harry U. Fuller, Chief Engr., Portland, Me., Water District, told how they permitted cabins to be built on a certain area of their shore line and at a safe distance from the intake. In every case the sanitary sit-

uation was carefully watched and had to be approved under a sanitary inspector constantly employed. In reforrestation some of their trees were twenty years old but more recently they had been depending on nature which was very successfully doing its own reforrestation.

Theodore Bristol, President, Ansonia (Conn.) Water Company, said that they preferred spruce to pines in reforrestation. One very good reason was the fact that his company in thinning out trees had been able to sell all the avaliable spruces for use as Christmas trees. The price obtained, is at the rate of 10 cents per foot, the smallest tree taken being 4 feet in height. The scheme had been making good money with the minimum per tree being 40 cents in the clear.

Afternoon Session

(President Leland G. Carlton, presiding)

Following the presentation and passage of the resolution quoted earlier in this report, the afternoon technical session got under way.

"Cooperation of Fire and Water Departments in Planning for Emergencies," by Samued J. Pope, Chief, Boston Fire Department.

Mr. Pope made an interesting talk from the point of view of a Fire Chief wishing to cooperate closely with the Water Department. He was of the opinion that Fire Department personnel should know the location of all important shut-off gates on the grid system, and be able to *intelligently* use these gates when emergency dictated. He advocated uniformity in the marking of such valves, as in the case of fire hydrants. He said that flow tests on fire hydrants should be made and the results should be supplied the Fire Department, and the responsibile individual should know these results.

Mr. Pope pointed out an interesting consideration in his recommendation that every available possible auxiliary fire supply capable of furnishing 5,000 gallons per minute and over, should be plotted. In this connection he referred to swimming-pools and all tanks of any size scattered over the distribution system. These might prove highly useful as a fire service supply, in addition to what the mains proved capable of supplying.

He liked the orange paint for hydrants, as it was considered ideal for visibility, and he thought the marking of the size of main on hydrants of considerable value to the Fire Department.

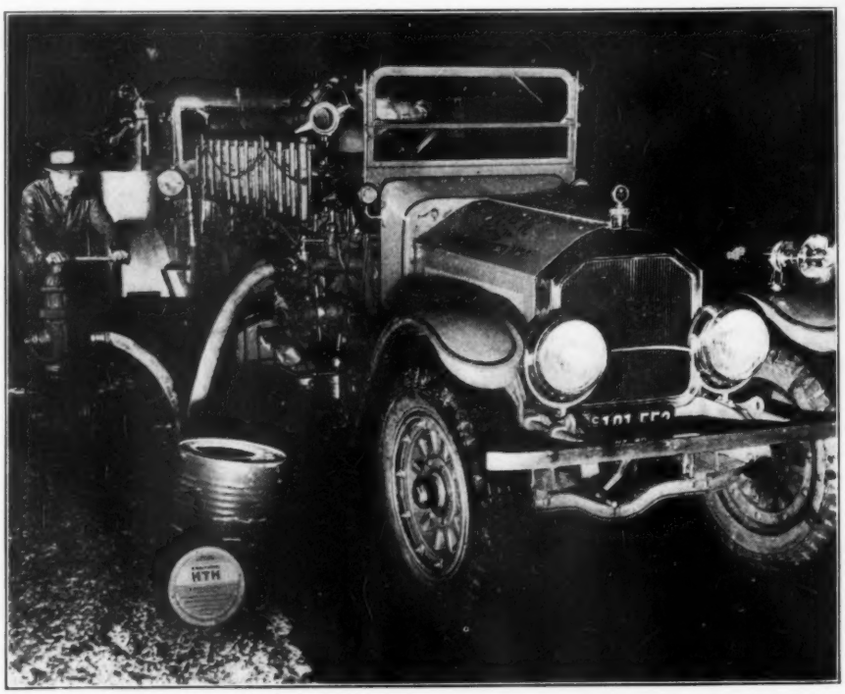
Concerning the matter of frozen hydrants, Chief Pope said that when a hydrant is found frozen it is extremely bad policy for the firemen to attempt to move to another hydrant, rather than to stay on the job and, with the thawing equipment on the pumper, put the hydrant into service. His reasoning was that to make a move may a too costly gamble. The next hydrant may also be frozen, and extremely valuable time will have been lost in the move.

In commenting on Mr. Pope's talk, President Carlton pointed out two interesting aspects of it. One: that the Chief was advocating making an emergency crew out of the Fire Department; and, two, the consideration of auxiliary supplies in buildings was something of a new slant possessing promise.

"Recent Pollution of the Rochester Public Water Supply Through Cross Connections," by Earl Devendorf, Ass't. Director, Division of Sanitation, New York State Department of Health, Albany, N. Y.

Mr. Devendorf very interestingly reviewed what had happened in the unfortunate Rochester case of cross connection pollution entering from a polluted fire main system into the domestic supply system. He described the 25 miles of city-owned separate fire mains of diameters of 4 to 24 inch, operating under a normal pressure of 95 pounds and a pumping pressure of 145 pounds during fires. The water from this so-called Holley Fire System is taken from the polluted Genesee River. Originally there had been 13 cross connections between this and the domestic system, these being ordered removed in 1928 by the Department of Health. It had been subsequently learned that many of these valves were sealed rather than being removed, such a situation being responsible for what happened on December 11th, 1940, when a certain valve was repaired by a maintenance crew. This certain valve proved later to be one of the cross connection valves between the two systems. According to rules, after the valve of mistaken identity was repaired, it was opened wide by the crew. The fact that the fire system pumps could not keep up the usual pressure led to a search which ended at the valve in question, but only several hours after it had been left open. Polluted river water had been going into the pure water system from 5:00 p. m. the 11th till 8:00 a. m. the 12th at the rate of 5 M.G.D. pumpage, creating wide pollution spread through the system.

Upon discovery of this calamity, radio, newspaper and all other means were used for broadcasting warnings to consumers. 50 sample stations were established and 165 hydrants were flushed. The chlorine dosage on the domestic supply was raised to the available maximum dosage, but after two days of such, in conjunction with flushing, residual chlorine had not been established in the affected part of the system. As result of this, followed something of a heroic measure, in the application of chlorine direct to the mains. A car



Fire Pumpers Do Strange Duty in Rochester
Speed Emergency Hypochlorination of Polluted Distribution System.

of high-test hypochlorite (H T H) was ordered by wire and rushed by Mathieson Alkali Works from Niagara Falls for the purpose of multiple point chlorination of the mains. To this end, 6 street flushers were used as solution tanks, and fire pumpers were employed to inject the chlorine solution into the mains. The solution was made on the spot by adding 5 pounds of the powder to the tanks and making up to 2,500 gallons to obtain a solution containing 168 parts of available chlorine. The pumpers taking this solution injected it under 50 pounds pressure through the hydrants into the main to obtain a chlorine dosage of approximately 5 parts per million until 0.4 parts residual was obtained at the hydrants being flushed. A day and a night of such injection was required.

By December 17th the water analyzed at the 50 sampling points on the system indicated the supply to be safe, and the citizens were so advised. The results to date indicate that only a possible (?) 4 cases of typhoid were caused by the accident. although 50 damage cases have been filed representing a total of $200,000 in claims. Mr. Devendorf commented that it was fortunate indeed for the people of Rochester that the sewage entering the river above the city was all receiving treatment.

Upon recommendation by the State Department of Health river water in the Holley System is to be discontinued. Plans call for a covered reservoir kept filled with the regular domestic water supply, this reservoir to supply the fire service pumps. Such had been agreed to in a conference with fire insurance interests.

Mr. Devendorf pointed out that the New York State Department of Health, as a result of the Rochester experience, had only recently repeated its warning to local water authorities, calling attention to their responsibility for cross connections on municipal supplies, the installation of double checks (Factory Mutual Approved Type) and fire chlorinators being the minimum required protection on such existing cross connections. A searching survey, now under way, had already revealed many illegal and dangerous inter-connections.

Richard H. Ellis, Engr., Associated Factory Mutual Insurance Co., Boston, in a discussion of Mr. Devendorf's paper, revealed that as an outcome of the conference referred to, in Mr. Devendorf's paper, the 150 sprinkler systems in the high-value district of Rochester would henceforth be protected with the domestic system water only. A decision had been reached to provide a three million gallon steel covered ground storage tank at the fire pumping station for storing pure Hemlock water. Such a reserve would supply the pumps for an adequate fire period and allow 45 pound residual pressure on the Holley fire system, as a minimum.

Mr. Ellis pointed out that the lessons learned at Rochester had revealed the value of the radio in notifying the public of hazards; the difficulty of chlorinating a polluted system; and the value of direct main disinfecting in such emergencies. He also pointed out that the Fire Underwriters were totally unaware of the presence of the cross connection valves of Rochester.

E. S. Chase, Consulting Engr., Boston, a former sanitary engineer with the New York State Dept. of Health, compared the disastrous case of cross connection pollution at Utica, N. Y., some years ago, when no such modern chlorination facilities existed as were available in the Rochester case.

Warren J. Scott, Chief Engr., Conn. Dept. of Health, made a plea that in the present defense movement it was wisdom to hold to the progress that had been made in recent years in regard to safeguarding cross connections in industrial plants.

F. H. Kingsbury, Senior Sanitary Engr., Mass. Dept. of Public Health, related an instance at Gloucester, Mass., in which, through an industrial cross connection, sea water had been pumped into the domestic supply system. In this case it was indeed fortunate that the salt content was sufficient to warn of the pollution and nobody was hurt. The sea water was happily free of pollution.

CORRECTIONS! CORRECTIONS! (Is Our Face Red?)

With the February review of "Developments and Trends in Sewerage Practices" appears a picture of the primary sedimentation units of the new treatment-works of Dallas, Texas. The caption to this picture (supplied by us and not the authors) states that these units are equipped with "Rex" sludge and scum moving cross flights, drawn toward the drives located on the center crosswalk to the sludge sump beneath. Further, that sewage enters beneath the center walk and travels in opposite directions through the tanks. All of which is in error, the "captioneer" becoming confused with another new plant in which all of these things are true.

At Dallas, facts are: The sludge and scum equipment are those of Jeffrey Mfg. Co. That the drive units are at the tank center is correct, but sewage does not enter at the center to flow in opposite directions. The flow is ordinary straight-line flow, from end to end, with flow baffling provided beneath the center walk. The sludge sump and cross collectors are at the inlet end of the tanks only, whereas the scum is collected at the center.

It's tough to get one's "drinks mixed" this way, the ony recompense being that this correction makes added publicity for two manufacturers, and the new plant at Dallas.

CORRECTION NO. 2

The second correction to be made is in connection with the pictures of members of the General Policy Committee of the New Sewage Works Federation. These appear on page 61 of our February issue. By mistake the picture of A. M. Rawn (Los Angeles) appears instead of that of Carl E. Green of Portland, Oregon. Mr. Rawn was elected a Director at Large for a 3-year term. Mr. Green was made a member of the General Policy Committee. In both cases the listing of committee members correctly shows the positions of Rawn and Green.

N. Y. SECTION TO FEATURE PROBLEMS IN ELIMINATING CROSS CONNECTION AND NATIONAL DEFENSE PREPARATIONS

At Syracuse, N. Y. (Hotel Syracuse) on Thursday and Friday, March 27th and 28th, the New York Section of A.W.W.A. will hold its Spring Meeting.

An advance copy of the program presages a well attended meeting, with important topics scheduled for open discussion in the two Round Tables planned. The first will deal with those eminently *"Practical Problems in the Elimination or Safeguarding Cross Connections,"* which confront water works managers pretty much in every community. The leader on this topic will be Hugh S. Dewey, Manager, Western N. Y. Water Co.

Another Round Table Session is devoted to *"Problems of Water Works Authorities in National Defense,"* under the leadership of W. L. Malcolm, Dir. School of Civil Eng., Cornell Univ.

A DEPTH SAMPLER

With Facilities for Controlled Intake at Rapid or Slow Rates

By R. D. NICHOLS
Jeffrey Manufacturing Co.,
COLUMBUS, OHIO

HAVING noted in the 1940 Reference and Data number of WATER WORKS AND SEWERAGE a device for taking depth samples of water, sewage, etc., called to mind a sampling device which was designed by the writer and considerably used at the Indianapolis Water Co.'s plant in conjunction with coagulation studies and development of the "Floctrol" units first installed in this plant. This device is illustrated in some detail in the accompanying line drawing.

In this work we were especially concerned with securing representative samples of flocculated water at various places and depths throughout the coagulation and clarification basins. In this it was important that the portions of water collected should contain representative floc particles in unbroken form. The device comprises a wooden handle to which is attached a cage which will hold the sampling jar in both open and closed positions. True samples at any desired depth can be taken by emptying the jar of water contained, when in position, and thereafter permitting the jar to fill very gradually.

Manipulating the Sampler

In operation the cage with the jar attached is lowered to the desired depth while in *open* position such as is shown in the right-hand view on the print. After reaching the desired depth the hand-operated air pump is moved to force air through the tubing to build up air pressure in the jar and force out the entrapped water. The completion of this phase of the operation can be ascertained by watching for the appearance of air bubbles at the surface.

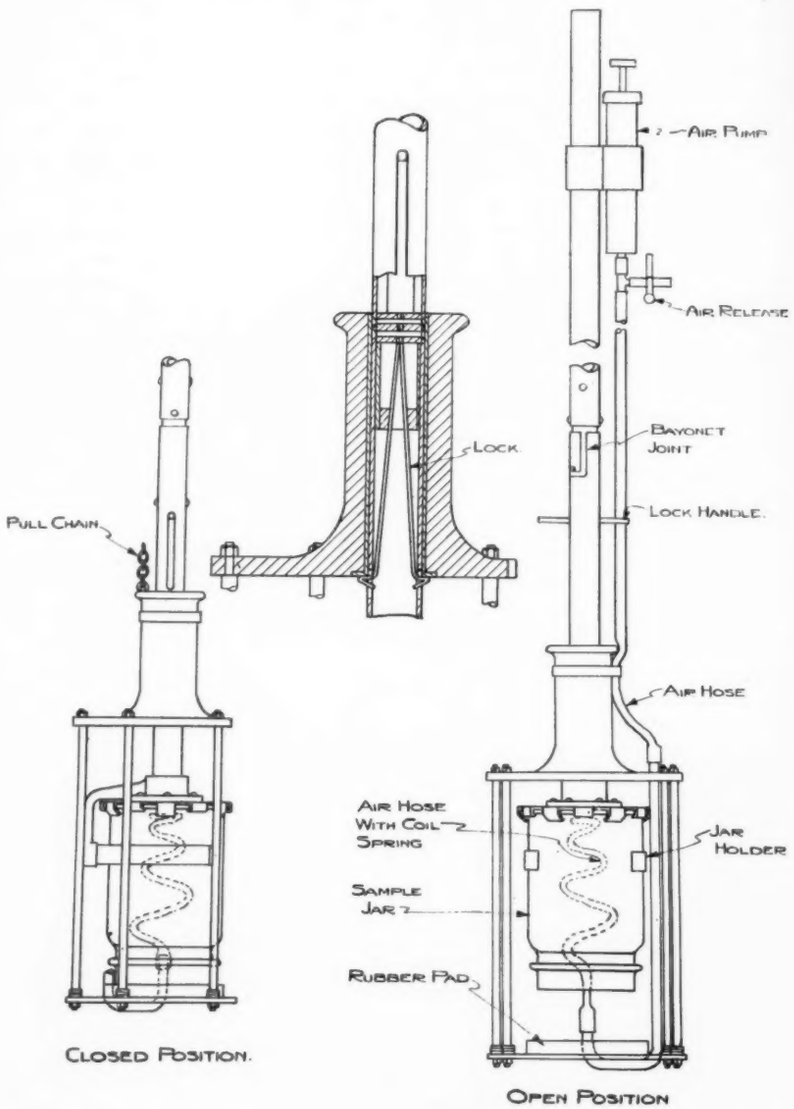
Then adjust the air release valve to permit very slow release of the air and thereby control the velocity of water flowing into the sample jar. When the jar is full of water the operator can determine when all air has been expelled by several methods. At Indianapolis we used a rubber tube and pinch cock. The pinched rubber tube having a very narrow orifice caused a slight "hissing" sound.

When the hissing stopped we knew we could proceed with "lifting" the sample jar. When the jar is filled with liquid a pull chain is operated to lift the cage to a position shown in the left-hand view, thereby making contact between a rubber pad and the rim of the jar.

The operation of closing the jar releases a spring lock which keeps the sample intact while withdrawing it from the body of water. We provided a bayonet joint in the handle a short distance from the cage. This permits disconnecting the handle at the joint and inversion of the cage and sample jar, after which lock was released by movement of the lock handle and the cage lifted to the open position for removal of the sample jar.

One of the fine points of design is the air hose inside the sample jar. This was made up of a rubber tube with a coil spring of fine wire inside of it so as to always hold the end of the tube in contact with the bottom of the jar, and to permit easy placement and removal of the sample jars.

One advantage possessed by this particular sampler is that the rate of sampling can be adjusted for a rapid or a gradual intake. Furthermore, the sample jar may be purged by emptying and refilling in position.



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Swing Diffusers

Fig. 2911 (right) Operating position and Fig. 2914 (left) diffuser tubes raised to tank walk. Simple regulation of air supply for Tapered Aeration. Tube cleaning without dewatering tanks or interrupting operation. Over 300 units installed. Ask for Bulletin 175.

Stationary Diffusers

Fig. 2907—"Chicago" Stationary Diffusers. Air main and tube holder combined in a single pipe provides maximum economy. Over 450 units installed. Ask for Bulletin 183.

Mechanical Aerator

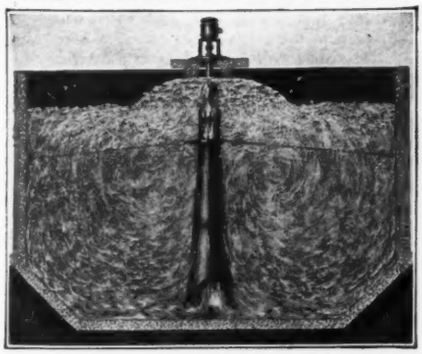
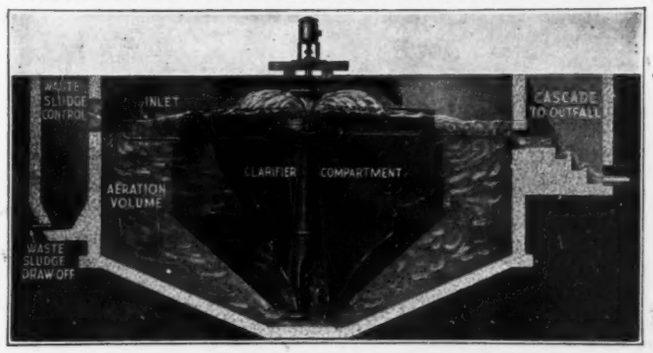


Fig. 2312 (left) — "Chicago" Mechanical Aerator for medium size towns. Over 150 units installed. Up to 98 per cent purification with low power and maintenance costs. Bulletin 128-L.

Fig. 2349 (right) — Combination Aerator-Clarifier providing complete treatment of sewage without odor nuisance and with minimum manual operation. Ideal for housing projects, small camps, institutions and small towns. Over 65 units operating successfully. Ask for Bulletin 128-K.

Combination Aerator-Clarifier



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REPRESENTATIVES THROUGHOUT THE UNITED STATES AND FOREIGN COUNTRIES

In Indianapolis

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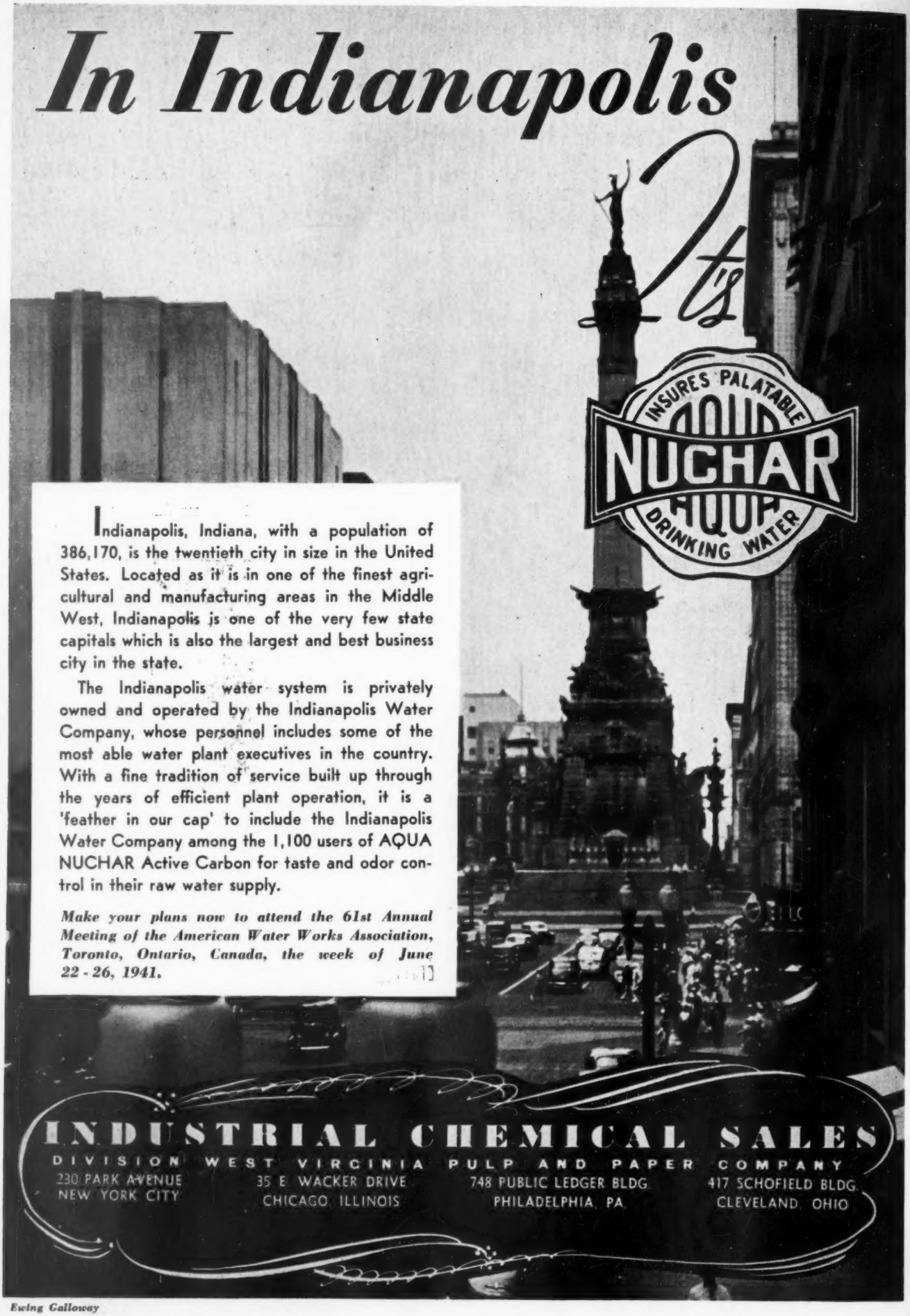

Indianapolis, Indiana, with a population of 386,170, is the twentieth city in size in the United States. Located as it is in one of the finest agricultural and manufacturing areas in the Middle West, Indianapolis is one of the very few state capitals which is also the largest and best business city in the state.

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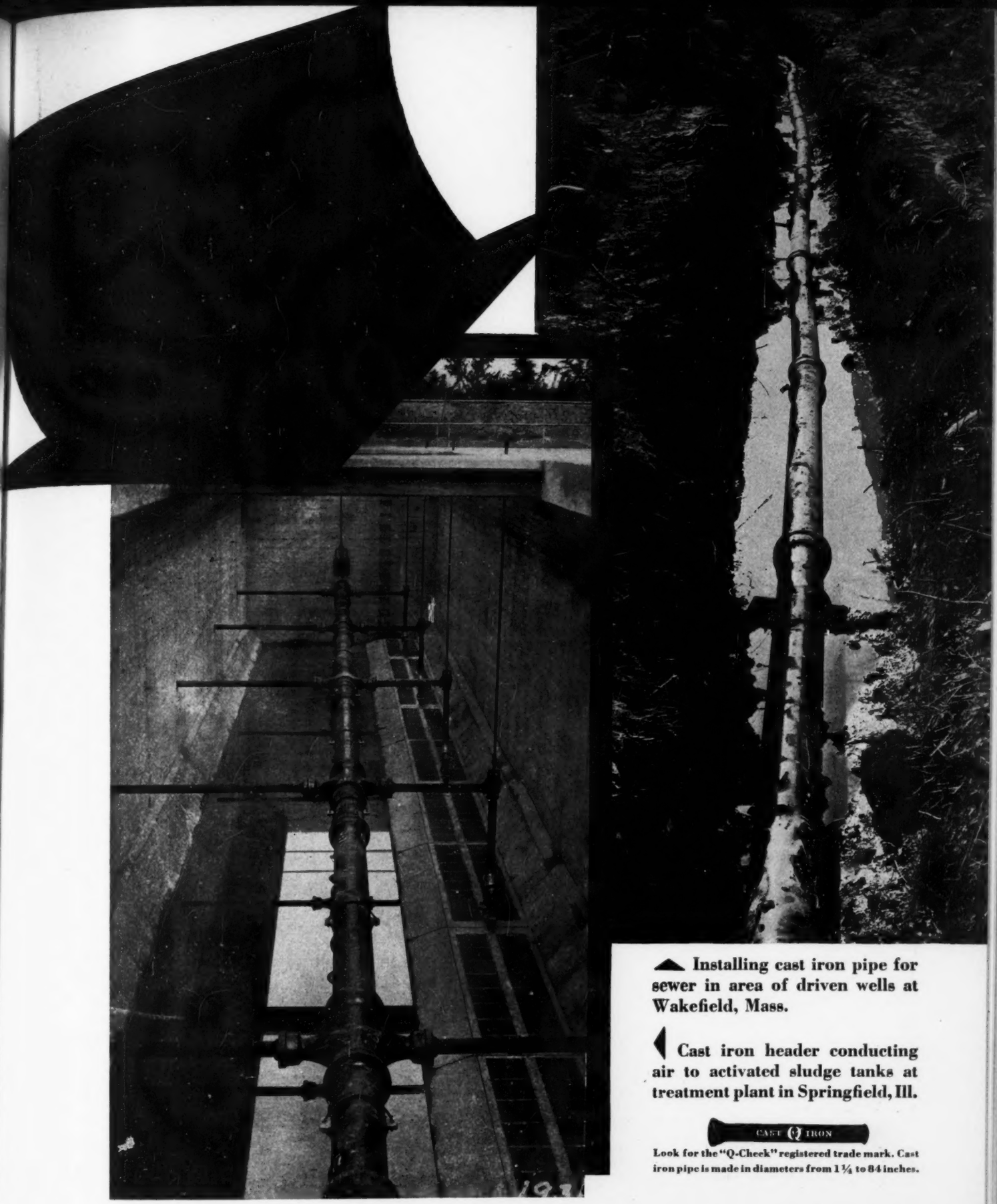

▲ **Installing cast iron pipe for sewer in area of driven wells at Wakefield, Mass.**

◀ **Cast iron header conducting air to activated sludge tanks at treatment plant in Springfield, Ill.**

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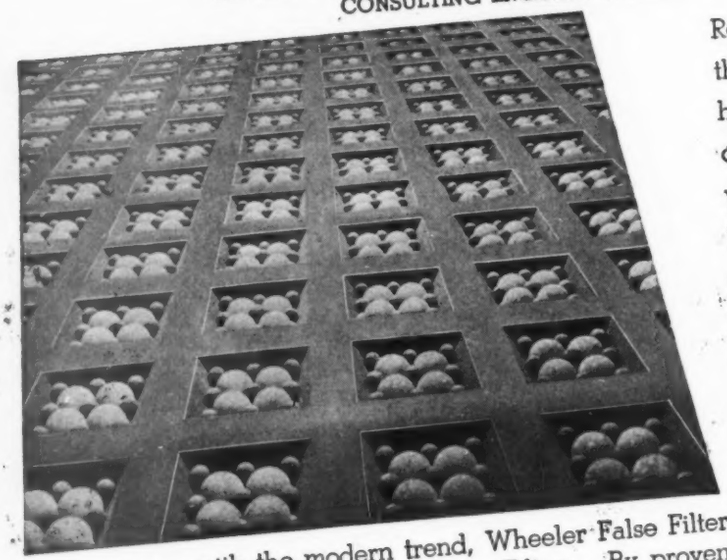

Relegated to obsolescence, by progress within the industry, Sandusky's original Filter Plant has been retired. This new Plant, which completely replaces the old, ranks with those which make the chapter of history for 1940 the most progressive of all. Modern in design, in architecture, and in all its appointments, the City of Sandusky can well be proud of this latest addition to its worthy group of civic enterprises.

Keeping apace with the modern trend, Wheeler False Filter Bottoms were selected for the Sandusky Filters. By proven engineering analysis, the most efficient underdrainage system yet devised, the Wheeler False Filter Bottom was chosen for most of the modern Plants constructed during 1940. Not only the most efficient, but embodying only imperishable materials and, being of monolithic construction, it is as permanent as the structures themselves.

And at Sandusky, Wheeler False Filter Bottoms were substituted for ferrous metal underdrains at a saving in cost to the City.

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AMERICAN WATER SOFTENING PLANTS OF ESPECIAL INTEREST

Part II of a Running Account of Observations Made During a Tour of Nineteen Typical American Softening Plants

By L. J. ALEXANDER
Operations Engineer
SOUTHERN CALIFORNIA WATER COMPANY
LOS ANGELES, CALIFORNIA

Williams Bay

Williams Bay, in Wisconsin, is a resort town having a population estimated to be about 700 during the winter months and 5,000 during the summer months. The water treatment plant was designed for a flow of approximately 600 G.P.M., to operate intermittently, and to be controlled automatically.

A pressure switch on the distribution pipe system controls the operation of the booster pump, while a float switch in the clear well operates the well pumps. Synchronized through interconnection with the electrical control circuit of the well pump are the lime feeder, the "Accelator" mixing equipment, the recarbonator, and the solenoid valves operating the rate of flow controller. The "Accelator" tank is a design of the International Filter Company.

When the plant is started, the motion of the sludge blanket in the bottom of the sedimentation section of the "Accelator" is very apparent. Although the water was about 14 feet deep, it was so lacking in turbidity that it was possible to take a photograph of the cloud effects in the sludge blanket. Of all the plants visited the effluent from this "Accelator" tank had less turbidity than the water from any other sedimentation tank. The treated clarified water is recarbonated before filtration.

The raw water has a very high content of hydrogen sulfide and, I

The Author

believe, a considerable quantity of iron and sulfur bacteria, because on the side walls of the "Aero-mix" induction chamber there were the usual slimes which are in evidence when these organisms are present in the raw water. No attempt has, as yet, been made to idenify the organisms present in this slimy coating on the walls. There was, however, no evidence of bacterial growth or slimes on the walls of the filter tank, nor in the clear well. The lime treatment for softening incidentally removes these bacterial growths. There have been no analyses made for manganese, but an analysis for iron indicated 0.9 p.p.m.

Unique Sludge Disposal

Sludge disposal at this plant is accomplished in a novel manner. All sludge from the plant passes to the sludge filter house, the lower portion of which is a concrete basin with a center dividing wall, making two concrete basins, each 15x31 feet. Upon the concrete floor of each basin, half-circle tile has been laid to provide an underdrain system. Covering these tile lines are fourteen inches of graded gravel, and six inches of filter sand.

The backwash water from one filter is allowed to flow onto this sand, and, as this water filters through the sand of the sludge bed, the first layer of sludge is deposited. The waste sludge from the "Accelator" is then diverted continuously to this basin during the period between filter washings. During this period the alternate bed is allowed to drain and dry. Just prior to the next filter washing, the bed is cleaned of the sludge putty, which is of a consistency that is easily shoveled. This completes the cycle and the bed is ready for re-use. The sludge putty is loaded into trucks and delivered to farmers in the vicinity, who use it as fertilizer.

One of these sludge basins had been cleaned two days prior to my visit to the plant. During the preceding nine days 2,573,000 cubic feet of water had been passed through one filter without need for backwash. The filter wash water and the "Accelator" sludge had accumulated to a depth of 9 inches on one of these beds during this period. This made a volume of about 350 cubic feet of sludge putty, which was produced by softening a raw water of approximately 360 p.p.m. to about 80 p.p.m. of hardness, by the addition of 3,600 pounds of hydrated lime per million gallons. The raw water

This constitutes the concluding installment of a series of thumb-nail sketches which highlight the more interesting and unusual features of design and methods of operation observed at nineteen water softening plants visited by Mr. Alexander.

On his planned tour of inspection, for the purpose of evaluating modern processes and the newer developments in water treatment equipment and plant design, the author chose what may be considered to be representative American softening plants. His notations take on especial interest as those of one interested in choosing the best in methods and equipment for particular situations and the production of a high-grade product at reasonable costs.

Part I of this review, which is to be found in "Water Works and Sewerage" for November, 1940, recounts features of the plants of Oklahoma City; Topeka; the St. Louis County Water Co.; the Mahoning Valley District, serving Youngstown, Ohio; Bloomington and Elgin, Ill.; Canal-Winchester, Ohio; and Fort Worth, Texas.

Twin Sludge Dewatering Beds at Williams Bay, Wisc.

(Bed on left is full and draining; that on right is ready for sludge and filter wash water.)

hardness is about half and half calcium and magnesium.

Clarksburg

Clarksburg, West Virginia, has one of the largest complete zeolite water-softening plants in the United States. Perkins Boynton is in charge of the plant, which is operated under the general direction of Scotland G. Highland, Secretary and General Manager of the Clarksburg Water Board.

The source of the water is the West Fork of the Monongahela River and varies in hardness from 80 to 392 p.p.m. An attempt is made to keep the hardness between 50 and 85. Normally the water has a very low pH, and is contaminated with acid mine wastes and some iron. It is brought into the proper pH range by hydrated lime and then coagulated with alum. Activated carbon is used continuously, and, following all treatment, chlorine is used for sterilization. Lime, alum, and carbon are all fed by ejectors into the discharge from low lift pumps, accomplishing the first mix. The discharge from these low lift pumps goes to around-the-end type of sedimentation basins where the detention period is about eight hours. From the sedimentation tank the water flows to sand filters. The clarified water clear well is under the sand filters in the old portion of the building. Hard water from this clear well is next pumped to sufficient elevation for operation of gravity zeolite filters. A soft-water clear well is under the zeolite filters in the new portion of the building. The sand filters and zeolite beds are constructed at the same elevation and in such manner that zeolite or sand may be placed in any of the filters.

In the new addition of the plant, which was primarily for zeolite softening, many features were added to provide flexibility to the sand filter and softening processes. No changes, however, were made in the old sedimentation basins.

The capacity of the zeolite beds is 4,000,000 gallons daily of zero soft water. Proportionate amounts of this zero soft water are added to the clarified river water to obtain the desired softness of the plant effluent.

[For an excellent illustrated description of the Clarksburg plant by Scotland G. Highland, see the April, 1939, issue of WATERWORKS AND SEWERAGE.]

Wheeling

Wheeling, West Virginia, is supplied with filtered and softened water from a treatment plant operated under the direction of Mr. A. R. Todd.

The source of the supply is the Ohio River. There is a great fluctuation in the character of the river water. The reason for such variation of character of the water is probably due to the sewage effluent from Pittsburgh and the trade wastes from various iron manufacturing plants and the mines up-river from Wheeling. The stream is rather flashy in its character of water and requires almost hourly checks.

The turbidity varies from 1 to 1,450 p.p.m. It has a very low alkalinity averaging about 3 p.p.m., and the carbon dioxide content is often as high as 45. Iron and manganese often reach 12 and 14 p.p.m., respectively. The pH of the river averages about 4.8. Such low pH makes coagulation and treatment difficult. This, however, has been overcome by the use of sodium silicate in addition to copperas for coagulation. Mr. Todd has found that as little as 0.2 of a grain of copperas and 0.2 of a grain of sodium silicate have given better results than as much as 3 grains of copperas alone.

Operator Caryl Ripley Exhibits Sludge Bed Under-drain Tiles at Williams Bay.

The mixing tanks are some distance from the feed machines, yet no great difficulty is experienced with the lime feed lines. A tremendous amount of water is used for dilution of the milk-of-lime solution from the slaking machines. The mixing basins are around-the-end type and are covered, while the aeration chamber, the grit chamber, and the sedimentation tanks are open.

Low lift pumps raise the water from the river and discharge it through the aeration nozzles. From the aerator, water passes through the grit chamber to the mixing basins where it receives pre-chlorination and the chemical dosage. When the river is acid, as it often is, it is necessary to use soda ash as well as lime to attain proper softening.

There are about six hours for detention in the sedimentation basin, and when, occasionally, activated carbon is required, it is applied at about the half-way point in the sedimentation basin.

A six-hour detention period gives a complete reaction of all the chemicals involved in the treatment. There is no provision made for mechanically cleaning either the mixing or sedimentation basins.

The feed machines are "home-made" by a local manufacturer who has developed an idea that has considerable merit. It is a rotating belt, the speed of which may be varied, and there is an orifice feed onto this belt, the size of which can also be changed. There is, however, no means of checking the quantity of the dose except by sampling.

Mr. Todd has been experimenting with surface wash for the filters. One filter has an installation of the Palmer type of surface wash, which is giving very good results.

Sludge from this plant is returned to the river.

Greendale

Greendale, Wisconsin, is a new and thriving community. It is one of two Federal Housing projects under the jurisdiction of the Department of Agriculture. The operation of the utilities is under the management of representatives of the Department. One requirement placed on the operation of these utilities was that the water softening plant be completely automatic. Zeolite softening and all operations attendant to the operation of the pumping equipment are controlled by an International Filter Co. "Robotrol." By means of this "Robotrol" the entire plant, well pumps, boosters, zeolite rate controllers, by-pass controllers, are interconnected electrically through pressure switches, float switches, and relays, so that the plant is operated on a 100 per cent automatic basis requiring once-a-day visits to see that all equipment is functioning correctly.

Water is pumped from wells by deep-well turbine pumps to coke-tray aerators. From the aerators the water flows to a sedimentation basin and then passes to down-flow zeolite filters. By proportioning rate controllers, a sufficient quantity of settled water is by-passed to the 100,000 gallon clear well to obtain a 6-grain (approximtaely 100 p.p.m.) water.

The coke-tray aerators are inclosed in a room which has forced draft ventilation, and, though there is evidence of a high concentration of iron, there is no evidence of iron or sulfur organisms accumulating on the surface of the coke, even though the coke is stained with hydroxide of iron.

The plant lacks mechanical facilities for handling salt. Correction of this disadvantage would overcome the one undesirable feature of an otherwise perfectly coordinated plant.

The Pipe Gallery at Clarksburg.

Neatly Arranged Piping Includes Air-Wash and Regenerating Brine Lines.

Lancaster

Lancaster, Ohio, a city of approximately 19,000 population, with an average daily water consumption of 1.5 M.G.D., has a zeolite water softening plant with a capacity of three million gallons daily.

The water is obtained from a group of wells. This water has a hardness of approximately 365 p.p.m. which is reduced to about 67 p.p.m. by zeolite softening with the consumption of 0.375 pounds of salt for each 1,000 grains of hardness removed.

At Clarksburg, W. Va.

The Recently Added Battery of Four IMGD Zeolite (Green-Sand) Softening Units, Making This Long Established Filter Plant One of America's Most Important Zeolite Softening Plants With Marked Flexibility of Operation.

Water from the wells is air-aerated and thereafter passes through coke-tray contact aerators directly onto sand filters. From the sand filters a portion of the water passes to the clear well and a portion to the upflow zeolite beds.

There is so much iron in this water that aeration produces some flocculation. This flocculation is not complete because, due to the discoloration of the zeolite, it is evident that a considerable quanity of iron has passed the sand filters.

The zeolite softeners are of the up-flow type. They are located in the main operating room and are without cover or protection of any kind. Up-flow filters are not the most desirable because there is some chance for contamination as the water flows from the surface of the zeolite softeners to the clear well. Post-chlorination overcomes such a potential danger at this plant.

Springfield

Springfield, Illinois, is a city with 85,000 people. It has a municipal water treatment plant operated under the direction of Charles H. Spaulding, who developed the Spaulding Precipitator.

The water supply comes from an impounding reservoir constructed on Sugar Creek. This reservoir is known as Lake Springfield, and has a threefold purpose: for water supply, for condenser water for the municipal light plant; and for recreational purposes.

The lake has been utilized to the utmost by the people of Springfield for recreational purposes. Boating, fishing, cabins and residences are permitted to the fullest extent. At one location on the lake the city has constructed an artificial beach by hauling in about 13,000 tons of sand. A line of sheet piling some distance out in the lake encloses the bathing area. Water, taken from the lake, is chlorinated and pumped into the pool, returning to the lake through orifices in the top of the sheet piling. In this way there is always fresh chlorinated water within the swimming pool, and by this means bacterial counts are controlled and coliform organisms are usually absent.

The municipal power plant takes water for its condensers from the lake. This power plant circulates approximately 37,000,000 gallons daily. The water used by the condensers may be continuously treated with six pounds of copper sulfate per million gallons, so that, if needed, there may be a continuous flow of copper sulfate treated water returned to the lake. Up to the present time it has not been necessary to use other copper sulfate treatment for the reservoir. In the winter raw water going to the filtration plant is taken from the condensers, thereby having the advantage of a higher temperature.

The Spaulding Precipitators produce excellent results. The effluent from these Preciptator tanks is so lacking in turbidity that it could probably be used without filtration. By means of these Precipitators the softening reaction is carried to completion through the sludge blankets, and recarbonation is not necessary. For raw waters high in magnesium it seems advantageous to use split treatment, though it is not necessary, to eliminate recarbonation.

Unique Filter Design

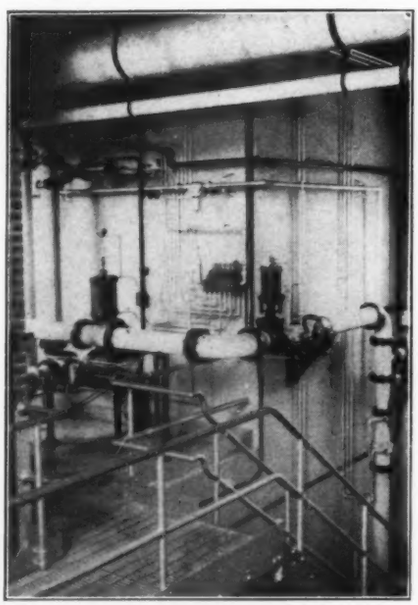
The filter construction at Springfield is quite interesting in that a very coarse sand is being used, one that probably does not get more than a 2-inch or 3-inch expansion in a 40-inch wash water rate. Prior to washing these filters a 1½-inch hose with a spray nozzle is turned on the surface of the sand, breaking up any crust which may have formed. Immediately following the hose wash, the filters look clean, but upon the introduction of wash water, all particles filtered from the applied water rise freely and flow off the sand bed. Wash water troughs in these filters were omitted to permit the operator to use a hose to wash accumulated scum and crust from the filter surface.

In this plant's construction, flexibility of operation was the paramount thought. It is possible to use the Precipitators in parallel, or series at will. Flow through filter units is automatically controlled by an attachment to the rate controllers, actuated by the rise and fall of water level in the clear well.

The sludge from the Precipitators is ponded in two one-acre plots. These sludge beds have not added to the appearance of the plant's grounds, but soon will be completely hidden by the landscape planting. These sludge beds are on level ground surrounded by low dykes, with no subdrainage. As a consequence, the material may remain for months at a time in the form of putty. At the present time there is active demand by the farmers for this sludge. Ten years ago, when the old plant was in operation, it was announced in the local paper that this sludge was good for fertilization. The farmers immediately took an interest and have been coming year after year in their own trucks and wagons for the sludge.

From Wheeling's Head House

Looking Across Aerators and Coagulating Basins Toward W. Va. Hills Beyond.



At Greendale, Wis.

Neatly Arranged Piping for This Automatically Operated Zeolite Plant.

Woodstock

The municipal water and electric plants of Woodstock, Ill., are located near the business district of the city. The water treatment plant was originally designed and constructed along conventional lines, with Dorr Clarifiers in the sedimentation tanks.

Increased use of water, due to growth of manufacturing in the town, reached a point such that the conventional plant was unable to treat enough water to meet the demand. The square concrete tanks were revamped and Spaulding Precipitators were installed in them. The flow into these precipitator units is in reverse to normal precipitator design. The water enters from behind a steel cone which slopes from the outside top to the bottom center. The rotating mechanism is installed in a central well, as is usual

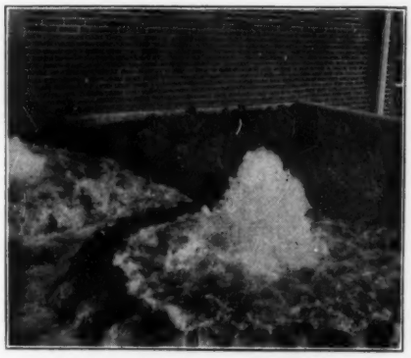
with a precipitator, but the effluent passes back over the top of the central cone to the outside periphery of the sedimentation tank.

The water supply comes from deep wells which were rotary drilled and gravel packed by the Layne Company. The raw water has a magnesium bicarbonate content of 156 p.p.m. and a calcium bicarbonate content of 197 p.p.m. These are reduced by treatment to 37 and 28 p.p.m., respectively. Chemical feed is accomplished by Omega Feeders.

When this plant was visited in company with Mr. Spaulding, we found it operating on split-treatment of about an 80-20 basis; that is, 80 per cent of all the raw water received the complete treatment, the remaining 20 per cent by-passed the first sedimentation tank and entered the second tank along with the treated water. All of the magnesium and most of the calcium were precipitated in the first tank and the precipitate coming from the second tank was practically pure calcium sludge.

The treatment was not entirely satisfactory. The precipitator tanks were being starved for sludge. In other words, the sludge blanket was not as deep as it should have been to accomplish proper treatment, because too much sludge was being drained from the bottom of the precipitator tanks. The ratio of treatment was changed by Mr. Spaulding while we were there, with a hoped for percentage of 70-30.

This plant was designed with many features for flexibility in mind, so that changes such as have just been described can be easily made. The plan originally had provision for recarbonation, but following installation of precipitators, recarbonation became unnecessary. However, there is some build-up of calcium precipitate on the sand grains.



Water From the Wells

Following Air-Aeration the Iron Rich Water of Lancaster Passes Coke Contact Aerators on Right and Then Direct to the Sand Filters Preceding the Zeolite Units.

Since the installation of the precipitators, the plant has a capacity greater than is necessary to meet the needs of the town at present, and is operated more or less intermittently.

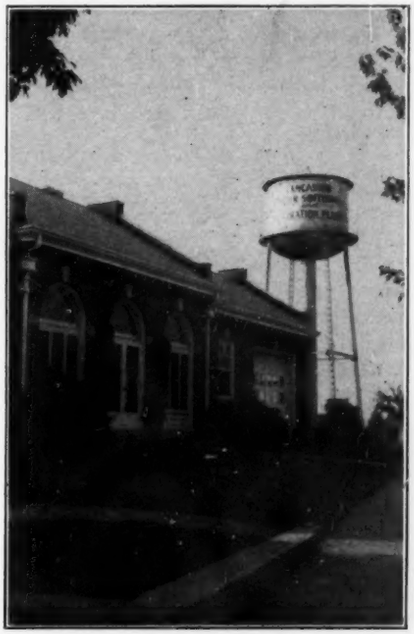
Because of more adequate conditioning of the water, prior to filtration, than originally existed, the filters are washed approximately every two weeks, in place of every twenty-four hours. Sludge disposal is accomplished by use of the sanitary sewer. No difficulty has been experienced because of deposition of lime sludge in the sanitary sewer.

La Grange

La Grange, Ill., has a municipal water softening plant treating a very hard well water. It is a combination lime and zeolite plant operated under the direction of J. W. Krause. The plant was placed in operation May 1, 1939.

Lime softening reduces the 930 p.p.m. well water to less than 500 p.p.m. of hardness, and 80 per cent of the lime softened water is further softened by zeolite. This zero soft water is mixed with the remaining 20 per cent of lime softened water to obtain a final hardness of the mixed effluents between 90 and 100 p.p.m.

The mixing tank, flocculating tank, and sedimentation basin, are separate compartments in a large rectangular basin. Link Belt mechanisms for mixing, flocculation, and sludge removal are used. In rectangular basins this type of apparatus seems well adapted.



Lancaster, Ohio

Boasts a Neatly Designed and Well Operated Plant.

Because the line softening is only partial, the sludge removed is pure calcium sludge. Removal of the magnesium hardness is accomplished by the zeolite.

The lime feed machine was designed for hydrated lime but the "wet-feed paddle" mixing machine is doing a good job of feeding unslaked lime. The use of a water injector has made this possible.

The sand filters are operated at the rate of about 1½ gallons per square foot per minute. Into the effluent from the sand filters, Proportioneers pumps inject 8½ pounds of "Calgon" per million gallons. It is believed that this percentage of "Calgon" added to the lime softened water will prevent accumulation of

The "Robotrols" at Greendale.

These Units Are the "Supervisors" in Automatic Operation and Bed Regeneration.

lime in the zeolite beds. Observations during the short period of operation seem to substantiate this belief.

The zeolite filters are of the upflow type and are completely enclosed. The operation of these beds may be viewed through a glass partition. The operating tables are outside the filter compartment. The top 2 inches of zeolite beds are becoming stained a brownish color. This may possibly be caused by corrosion of the brine and wash water pipes which are of steel.

Recarbonation of the lime softtened water requires about 20 gallons of oil per million gallons.

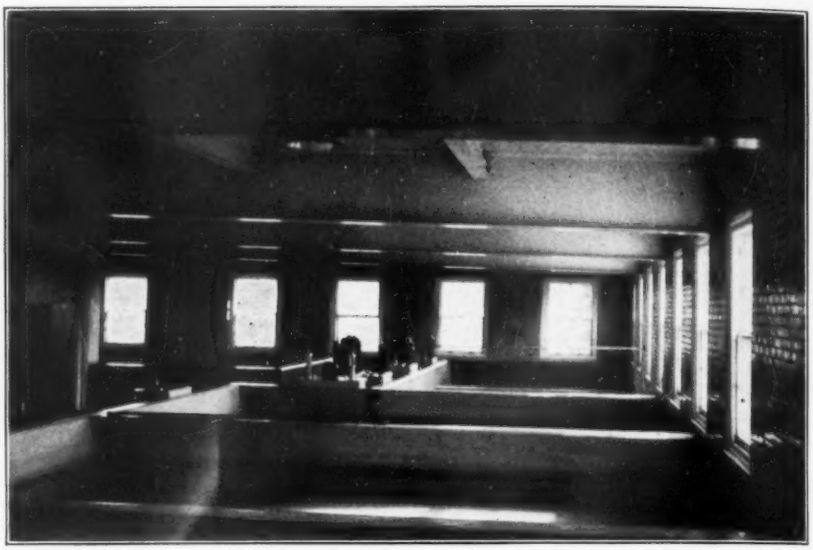
No trouble was experienced when softened water was pumped to mains which had been carrying water of 900 p.p.m. of hardness.

Lubbock

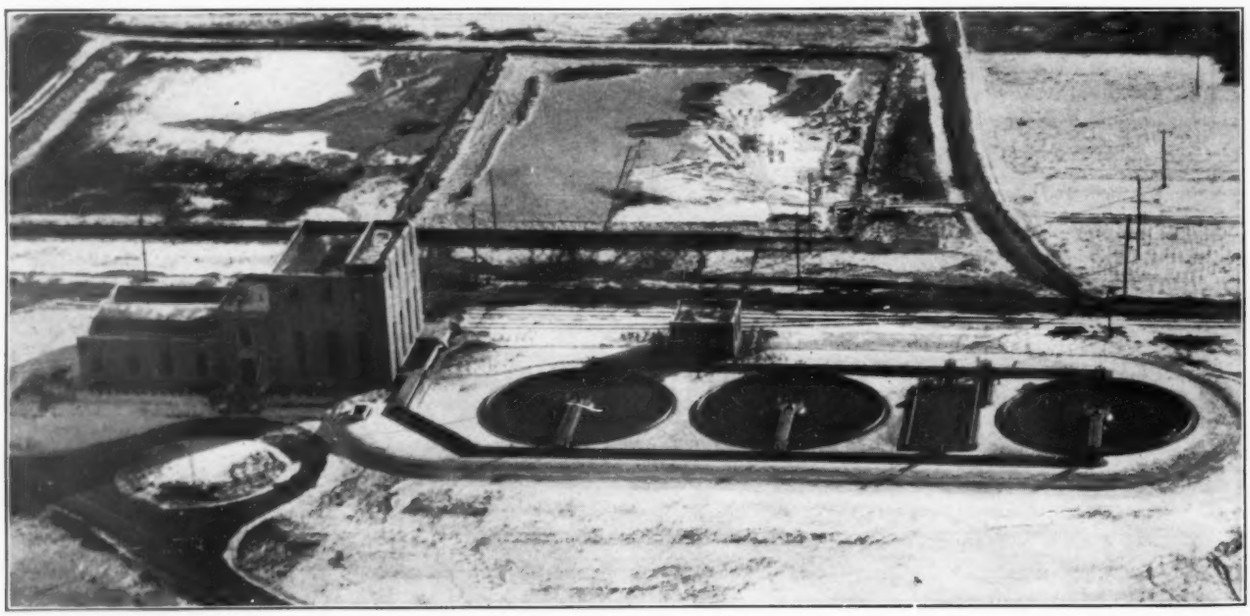
Lubbock, Texas, a town of 35,000 population, has a municipal water supply with no treatment except chlorination. Lubbock is the seat of Texas Technological College, which has its own water supply. The school's water supply has a fluoride content of 4 to 5 p.p.m., and is also untreated except for chlorination. Such treatment is typical in this section of Texas, although there are some supplies containing as much an 8 to 10 p.p.m. of fluorine.

Dr. R. C. Goodwin, in charge of the Chemistry Department, is making experiments on the removal of fluorides from the water. The usual tests for fluorine have not proved very satisfactory here. This may be because of the high concentration found in these waters. Diluting the samples to obtain concentrations of fluorine within the range of the Sanchez and other methods has given them erratic results. (The Sanchez method gives good results for fluorine concentration below 3 p.p.m.) Dr. Goodwin can see no reason for this unless there is some buffer salt in the water which may be giving trouble. In checking the methods with distilled water and known concentrations of fluorine no trouble is experienced.

In tests, so far, it has found that considerable care must be exercised in the choice of filter media. Two exchange materials have been used in Dr. Goodwin's experiments, activated alumina and tricalcium phosphate. Activated alumina seems to require that the removal of fluorine be continuous because the exchange action reverses and the fluorine returns to the water which has been standing in contact with the beds. There has, as yet, been no definite proof that tricalcium phosphate will act in a similar manner. If a bed using activated alumina is taken out of service it must be run for a protracted period prior to the time the effluent is to be used again, or the bed should be regenerated before being used. For this reason, removal of fluorine will be questionable in results obtained until satisfactory quick tests (comparable to O.T.O. for chlorine) is found. Dr. Goodwin is now trying to solve this major



The Operating Floor at Lancaster.



The 12 M.G.D. Plant of Springfield, Ill.

Here Chas. H. Spaulding, Plant Supt. and Chemist, Developed the Spaulding "Precipitator." The Three "Precipitators," Good for 4 M.G.D. Each, Are Seen in This Picture. Filter Design in This Plant Is Also Ultra Unique.—See Text.

problem; i.e., a quick test for the determination of the fluoride content which would be applicable in practice. Such a test should be applicable to determine when a bed is exhausted and ready for regeneration, also whether there has been complete regeneration.

At Dr. Goodwin's experimental plant, the wash waters used for regeneration of the bed have a fluorine content of 30 to 50 p.p.m. and higher. Dr. Goodwin, at the present time, is using an experimental filter furnished by the International Filter Co. This filter is charged with "Defluorite," which is the trade name used by International Filter Co. for a compound of apatite and tricalcium phosphate.

Consolidated Edison Co. Waterside Station

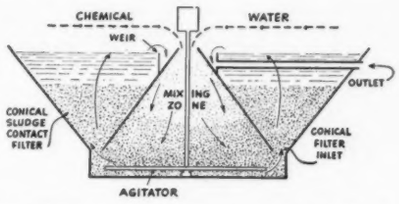
The Consolidated Edison Co. of New York City has a large industrial water treatment plant producing boiler feed water. About 25% of the discharge steam from the turbo-generators is delivered to the New York Steam Co. This steam is then piped to many of the large buildings in the 42nd Street area of New York City, and used for heating.

With such demands on the water supply of the plant, it is natural that an attempt should be made to produce a water which will meet the rigid requirements to produce steam of nearly zero CO_2 content. This is being done by the use of carbonaceous zeolite. This zeolite treatment is in two sections, one section operating on the sodium cycle, and the other section operating on the hydrogen cycle. The zeolite beds are contained in steel pressure tanks specially treated. Following the "Zeo-Karb" units there is a large degasifying unit to remove the carbonic acid. There is special proportioning equipment to blend the effluents from the sodium and hydrogen cycles. The plant has a capacity of 1,200,000 lbs. per hour.

Chicago Ice Plant

The Chicago Ice Plant has installed a carbonaceous zeolite water treatment plant to treat Chicago city water. It produces an unusually good water for its raw material.

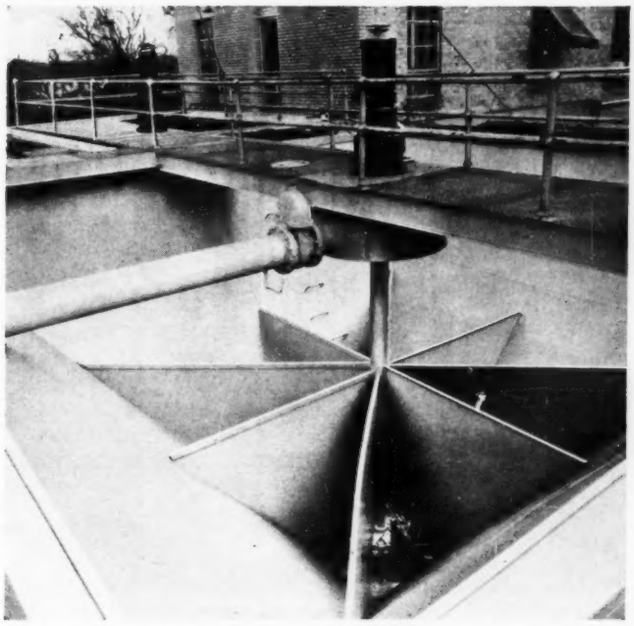
This carbonaceous zeolite plant is relatively small, and is operating on the controlled exchange hydrogen cycle. The washing, rinsing, and recharge are governed entirely by quantity of flow measured through the meters, rather than by any control checks of the analysis of the water passed.



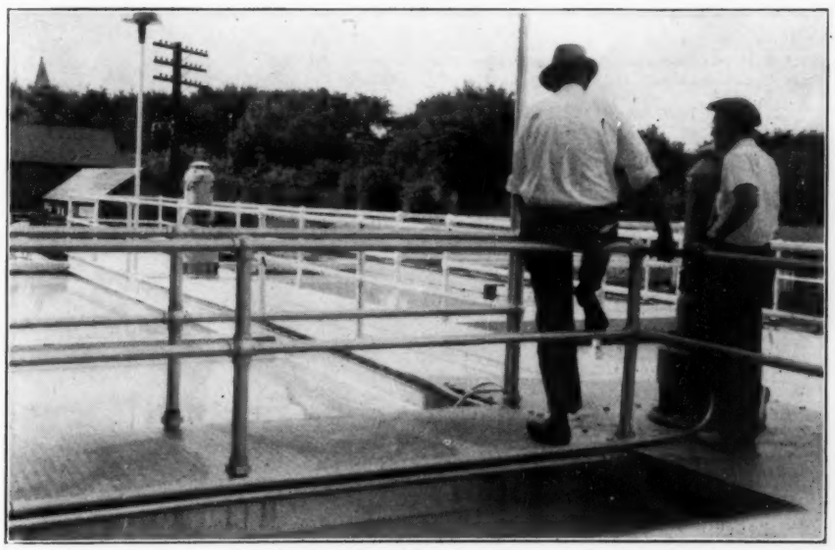
Typical Section Through Spaulding's Up-flow Precipitator.

Four hundred pound cakes are frozen with only one core pull, and the appearance of the ice is excellent. The ice is clear, free from checks, white butts, foggy cores, and is a "tough" block.

The cost of carbonaceous zeolite at the present time would probably prohibit its use for domestic water supplies. For the manufacture of ice, however, where water requirements are special and rigid, the use of carbonaceous zeolite is economical.



One of Woodstock's "Precipitators" Dewatered
To fit into existing settling basins the Woodstock units are of rectangular construction.



At Woodstock, Ill.
The Overloaded Conventional Plant Has Been Revamped and Spaulding's Precipitators Installed in the Existing Basins, Involving a Unique Arrangement.—See Text.

ANHYDROUS AMMONIA

Its Storage, Feeding and Safe Handling

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The Mathieson Alkali Works, Inc.
NEW YORK, N. Y.

DURING recent years which have seen rapid growth in the use of ammonia in water purification practice, much excellent material has been written on the chemistry and technique of ammonia-chlorine water treatment processes. As a means of assisting in the more effective application of ammonia in these processes, and to meet a request from the editor of "Water Works and Sewerage," it is the purpose of this article to present some of the more significant physical and chemical properties of ammonia, together with information concerning the safe and efficient handling of ammonia and ammonia containers.

What Is Ammonia?

As distinguished from elemental gases such as chlorine, oxygen, nitrogen, etc., ammonia is a compound gas. It is composed of two gaseous elements, nitrogen and hydrogen, in the proportion of one part of nitrogen to three parts of hydrogen by volume—the formula being (NH_3). However, since one volume of nitrogen (as gas) weighs fourteen times as much as an equal volume of hydrogen, on a weight basis the proportions assume the relations of fourteen parts of nitrogen to three parts of hydrogen.

Ammonia was originally produced in commercial quantities solely as a by-product from the destructive distillation of coal in the manufacture of coal-gas and coke. Advances in science and technology coupled with increasing demands made other supplies available. Today, the most important production of ammonia is by means of the synthetic process which combines elemental nitrogen and hydrogen.

Since air consists of approximately 80 per cent nitrogen, almost 20 per cent oxygen, and minor quantities of other gases, the atmosphere serves as a limitless reservoir of nitrogen.

In the atmospheric synthetic ammonia process, nitrogen is separated by first liquefying air and then subjecting the liquid air to a fractional distillation. Thereby, nitrogen of very high purity is obtained.

The hydrogen necessary for reaction with nitrogen is obtained from several sources. In some instances water gas, which is largely a mixture of hydrogen and carbon monoxide, is used. The hydrogen is separated and purified by a number of different processes. Another source of hydrogen is the process of electrolyzing salt to produce caustic soda and chlorine. Hydrogen is one of the gaseous products from this reaction. Since it is relatively highly concentrated and carries few impurities, hydrogen from chlorine-caustic cells is readily brought to a condition satisfactory for the production of ammonia.

Nitrogen and hydrogen in a high state of purity when brought together in the presence of a suitable catalyst, under pressure and at elevated temperature, will combine to form ammonia. Refrigeration, compression and other common methods of gas separation and purification are used to bring the ammonia to a liquefied condition, suitable for commercial packaging and shipping.

Physical Properties of Ammonia

Liquid ammonia is a colorless, mobile and strongly refrigent liquid which boils at —28° F. (—33.35° C.) under atmospheric pressure. When the liquid is cooled to —107.86° F. (—77.7° C.) it solidifies to a white crystalline mass. At ordinary temperatures and pressures, of course, ammonia exists as a gas which is highly soluble in water.

Gaseous ammonia has a sharp, pungent odor. It is much lighter than air, having a density (with air as unity) of 0.5971 at standard conditions of temperature and pressure. Liquid ammonia, unlike liquid chlorine, is much lighter than water, having a density of 0.6234.

The following table presents the more important physical constants of ammonia:

Physical Constants of Ammonia

Molecular symbol	NH_3
Molecular weight	17.032
Boiling point (1 atmosphere, 760 mm. Hg)	—28° F., —33.35° C.
Freezing point, (1 atmosphere, 760 mm. Hg)	—107.9° F. —77.7° C.
Critcal temperature	270.3° F., 132.4° C.
Critical pressure	1,636 lbs./sq. in. (absolute)
Latent heat (at —33.35° C.)	326.9 cals.
Vapor density (air=1)	0.5971
Vapor density (lbs./cu. ft.)	0.0446
Liquid density, at boiling point	0.6234 (water = 1)
Liquid density (lbs./cu. ft.)	42.56
Specific volume (cu. ft./lb)	22.42

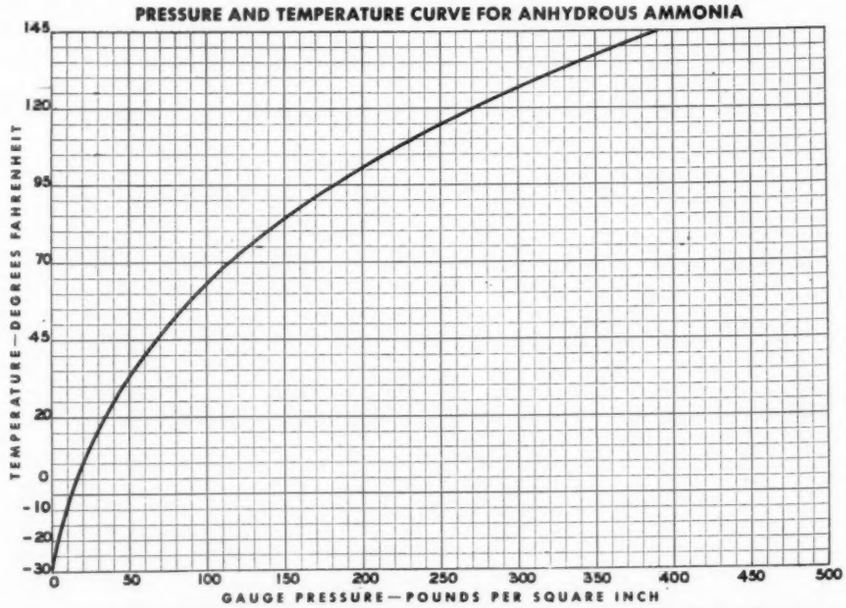


Fig. 1—Curve Which Reveals Pressure Changes in Ammonia Containers at Various Temperatures

(Note that at 72° F. the pressure is approximately 120 lbs. and only 50 lbs. at 32° F. At recommended limit, of 110° F. the pressure mounts to 230 lbs./sq. in.)

[1]Director of Chlorine and Ammonia Sales.
[2]Technical Service Engineer.

As ammonia is a gas at ordinary temperatures and pressures, liquid ammonia has a definite vapor pressure which varies with temperature. This relationship is graphically shown in Fig. 1.

When liquid ammonia, confined in a cylinder, is heated, it expands with a consequent change in density; this change is shown in Fig. 2. If the temperature should reach 145° F. then the cylinder would be entirely full of liquid ammonia. Higher temperatures are considered dangerous because they may cause the cylinder to rupture, due to the establishment of hydrostatic pressure rather than gas pressure.

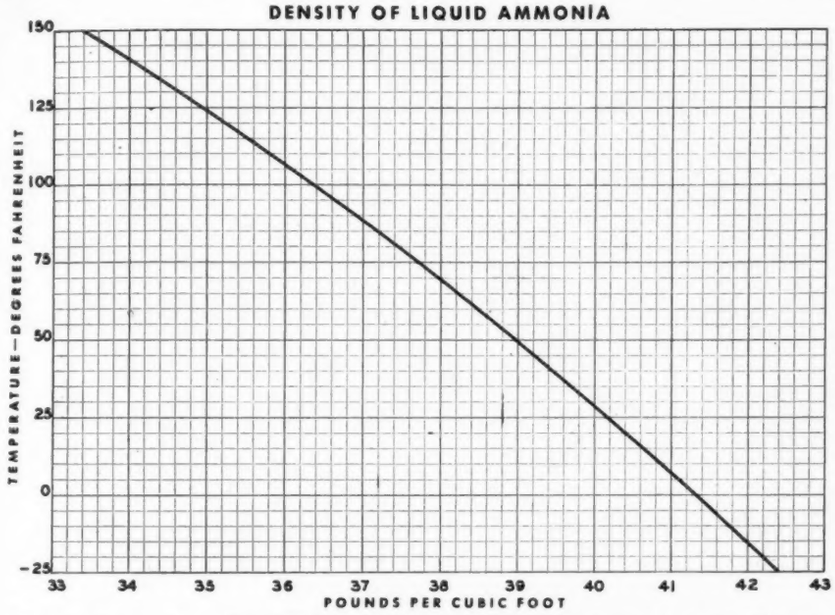


Fig. 2—Curve Revealing Effect of Temperature Rise in Increasing the Volume of Anhydrous Liquid Ammonia

(Should the temperature mount to 145° F. cylinders will be entirely full of liquid ammonia. This consideration stresses the dangers of high temperatures and the limitations imposed on quantity loading of containers at the factory. At 145° F. the pressure would be 390 lbs./sq. in., but the real danger is that full containers have to withstand hydrostatic pressures which bulge the cylinder walls which ends in eventual rupture.)

Chemical Properties of Ammonia

Under normal conditions, ammonia is a very stable compound. It takes excessive temperatures (in the order of 1000° F.) to cause it to dissociate even slightly. When this happens the products are nitrogen and hydrogen. The gas will neither burn nor support combustion. However, air containing from 16 per cent to 27 per cent of ammonia represents an explosive mixture which can be exploded by sparking.

The common metals are not affected by dry ammonia. Moist ammonia will not corrode iron or steel but will rapidly react with silver, copper, brass, zinc, aluminum and many solders and alloys, especially those containing copper, zinc or silver. It is thus evident that none of the latter materials should be employed for piping ammonia or ammonia water, whereas iron or steel is satisfactory.

Ammonia has a high affinity for water, reacting with it to form ammonium hydroxide (NH_4OH). Therefore, ammonia gas is highly soluble in water. At 32° F. one volume of water will dissolve 1,150 volumes of ammonia, or, on a weight basis, 47.3 per cent of ammonia gas (NH_3). Since the vapor pressure of ammonia increases with rising temperatures the solubility of ammonia in water should also decrease as the temperature rises. This is true, as is shown graphically in Figure 3. The high solubility of ammonia in water is of benefit in the design of ammoniators used in water treatment. In such machines the gas is dry-fed directly to the water supply through a diffuser, without the necessity of first preparing a water solution as is prevalently practiced in chlorination.

Ammonia Containers

Two general types of containers, tank cars and cylinders, have been accepted by the Bureau of Explosives of the Interstate Commerce Commission and by the Association of American Railroads as being suitable for shipping anhydrous liquid ammonia. The tank car is a single unit car, similar in appearance to that used for oil and liquid chlorine shipments. (As only a limited number of large scale consumers can handle this type of car, it is unnecessary to discuss this here.)

Cylinders used for shipping liquid ammonia are of two types: the tube-type illustrated in Fig. 4 and the so-called bottle-type shown in Fig. 5.

Tube-Type Cylinders

Tube-type cylinders are available in three sizes. They have capacities of 50, 100 and 150 pounds of ammonia — practically 100 per cent NH_3. The overall dimensions of these cylinders are shown in Fig. 4. The valves have a 37° standard ⅜-inch pipe cap outlet and are fitted with an internal dipper pipe. A dipper pipe is merely a pipe attached to the valve and extending inside the cylinder so that ammonia in liquid form may be withdrawn without turning the cylinder upside down. In water works practice we have never heard of this method of withdrawal being used. Consequently it is usually important to see that the dipper-pipe is pointing up when making connections. The average net and tare weights of these cylinders are also given in Fig. 4.

Bottle-Type Cylinders

The bottle-type cylinder illustrated in Fig. 5 has a 90° valve with a standard ⅜-inch recess pipe thread; it too has an internal dipper pipe. This container is of one size only and holds 100 pounds of ammonia. The dimensions of this cylinder and its average net and tare weight are also given in Fig. 5. Due to the fact that this cylinder, like chlorine cylinders, stands in a vertical position, it occupies a minimum amount of floor space and is, therefore, convenient for use where space is of primary importance. Also, the right-angle valve outlet, and the non-necessity of considering the position of the dipper-pipe, makes connections to ammoniating apparatus an easy matter, requiring less attention.

Ammonia cylinders are made of steel, the specifications for the steel being rigidly outlined by the Interstate Commerce Commission, and are regularly tested by the ammonia shipper to insure safety in use. The test consists of filling the cylinders with water, exerting a pressure of 700 pounds and measuring the amount of expansion. After this, the pressure is released

and the cylinder is again measured to determine to what degree it may have been permanently distorted. If the permanent distortion is too great the cylinder is discarded.

Handling Ammonia

It is important, in the handling of ammonia, to recognize that it is a liquefied gas stored under pressure and that as such, containers should not be subjected to abnormal mechanical shocks and *temperatures should not exceed* 110° *F.*

Cylinders should be stored in a cool, dry place, preferably away from cylinders containing chlorine. Accidental leaks may permit mixing of chlorine and ammonia gases. When these two gases are mixed a dense white cloud of ammonium chloride is first formed; but if chlorine predominates in the mixture explosive *nitrogen trichloride may be formed.* If the two liquids happen to be mixed the resulting reaction may produce nitrogen trichloride and consequent explosion.

The room in which ammonia cylinders are stored and used should be equipped with an exhaust fan *located near the ceiling.* In case of a leak the ammonia, being lighter than air, will rise and be removed. (The reverse is true in the case of chlorine gas.) Bottle type cylinders should always be *stored upright.* Tube type cylinders should be stored horizontally, and blocked to prevent rolling.

When not in use, valves should be protected by keeping caps in place. *Bottle type cylinders should never be lifted by passing a rope or chain through the cap slot,* as this may result in a broken or strained valve. If gaseous ammonia is to be withdrawn from the cylinders, they should be kept in the room housing the ammonia equipment for at least 24 hours before placing in use, in order that the contents may come to room temperature. If the ammonia gas is not at the same temperature as the ammoniating equipment, reliquefaction may take place in the feed line. This occurs only when the ammonia gas is warmer than the pipe line and some of the gas is liquefied by the chilling under the higher pressures.

Withdrawing Ammonia

To withdraw liquid ammonia, both types of cylinders must be placed horizontally with the eduction pipe dipping into the liquid. To withdraw gas, the tube type must be turned so that the end of the dipper pipe is not in the liquid ammonia, or the cylinder may be stood at an angle or on end. The bottle type will of course deliver only gaseous ammonia when standing upright.

The packing gland nuts, on ammonia cylinder valves are equipped with *left-hand* threads so that they will not "follow" the valve stem if the valve stem should adhere to the packing.

The amount of gaseous ammonia that can be withdrawn from any particular cylinder depends upon the surface area of liquid ammonia and upon the temperature of the air surrounding the cylinder. Thus it is obvious that the tube type cylinder, when in a horizontal position, will furnish more gas in a given time than the bottle type, other conditions being equal. The bottle type will discharge approximately 10 pounds per 24 hours, whereas the tube type will deliver at more than twice this rate—namely, 24 to 36 pounds per 24 hours, depending upon the size cylinder used. When greater quantities of ammonia are required a battery of cylinders may be connected to a single feed line.

Piping and Valves

Since moist ammonia will rapidly corrode copper and its alloys, valves and piping of these metals should never be used. The only permissible materials of construction are iron and steel. Piping may be of the extra heavy, rigid, steel type, or, in the case of short connections, of flexible steel. Screwed fittings may be used on temporary equipment, but flange, tongue and groove fittings, or ground joints should be used on all permanent installations. When screwed fittings are used they should be made up with litharge and glycerin cement. With flange fittings use either lead or asbestos composition gaskets. Valves or pipe lines should be of the all-steel type, especially designed for use with ammonia.

Leaks

A leak in the ammonia valve, valve connections, ammonia feed lines and in the ammoniator connections generally indicates its presence by the characteristic odor of ammonia. The exact location of the leak in any of these places may be detected by holding an open bottle of hydrochloric acid near the suspected leak. A burning sulfur taper or moist phenolphthalein paper may be substituted for the hydrochloric acid bottle. When gaseous ammonia comes in contact with fumes of hydrochloric acid or fumes from a burning sulfur taper, a dense white fog is produced. Moist phenolphthalein paper will turn red due to the alkalinity of the ammonium hydroxide formed by the absorption of the ammonia in the moist paper. It is of course possible to substitute strong chlorine water for hydrochlorine acid in tracing leaks.

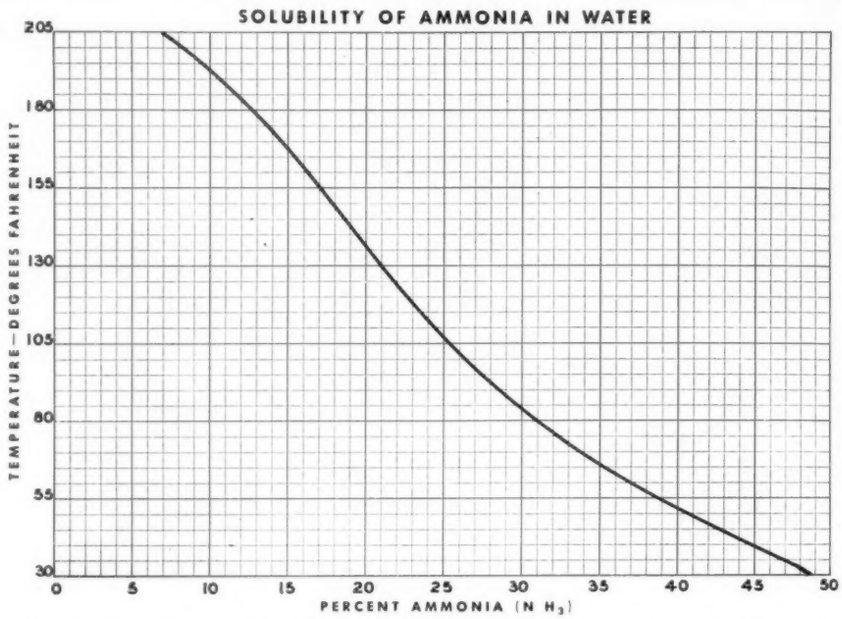


Fig. 3—Curve Revealing the Solubility Range of Ammonia Gas in Water at Various Temperatures

(The marked solubility of ammonia in water as compared to chlorine and other gases is revealed. At freezing temperature a saturated solution will contain 47.3 *per cent of* NH_3 *gas by weight. Even at* 100° *F., water will carry better than* 26 *per cent* NH_3 *by weight.)*

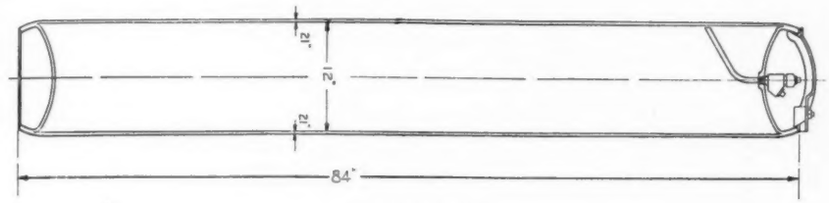
Only an authorized person familiar with the plant should attempt to stop a leak and if there is any question as to the seriousness of the leak, a gas mask should be worn. All persons not equipped with masks should leave the affected area until the leak has been investigated. The mask should be of the type approved by the U. S. Bureau of Mines for use with ammonia. It should be stored at the most convenient point where the atmosphere cannot become contaminated with ammonia. When a mask is not available, a cloth or sponge soaked in water and held over the mouth and nose provides temporary protection.

When there is a leak around a valve stem, it can usually be corrected by tightening the packing gland nut. In case of serious cylinder leaks, such as leaks around the bottom of the valve, the cylinder should be removed to a point away from the building. If possible its contents should be discharged to the atmosphere where it will be rapidly dissipated. When a leak occurs in a congested area where atmospheric dissipation is not feasible, the ammonia should be absorbed in water. Fortunately this procedure is very simple and easily done because of the marked solubility of ammonia in water. Thus the ammonia may be saved by making a solution, or it may be wasted into a flowing sewer, as long as the gas enters beneath the surface of the sewage.

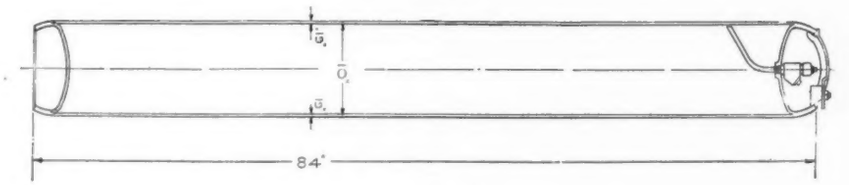
Flooding with a large volume of water from a hose will lessen vaporization as the vapor pressure of ammonia in water is much less than that of liquid ammonia. *Liquid ammonia should not be neutralized with acid—the heat generated by this reaction may increase the fumes.*

In case of fire every effort should be made to remove ammonia cylinders from the premises. If they cannot be removed then the firemen should be notified as to their location, because it must be recalled that optimum mixtures of air and ammonia (16 to 20 per cent NH_3) will create an explosion if ignited.

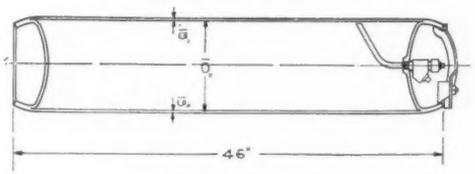
Sectional Views of Cylinders



150-lb. Cylinder
Net wt. .. .. 150 lbs.
Tare wt., average 238 lbs. | Without Cap*
Gross wt., average 388 lbs. | Cap*



100-lb. Cylinder
Net wt..... 100 lbs.
Tare wt., average 165 lbs. | Without Cap*
Gross wt., average 265 lbs. | Cap*

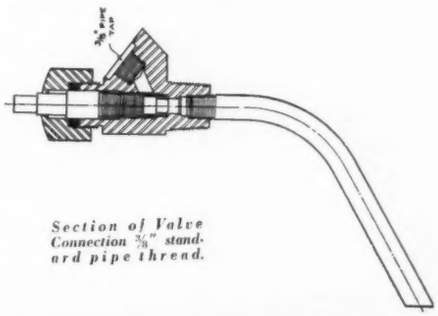


50-lb. Cylinder
Net wt..... 50 lbs.
Tare wt., average 102 lbs. | Without Cap*
Gross wt., average 152 lbs. | Cap*

*Average weight of caps

for 150-lb. cylinder—6½ lbs.,

for 100 and 50-lb. cylinders—6 lbs.



Section of Valve Connection ⅜" standard pipe thread.

Fig. 4—Dimensions, Capacities and Weights of Ammonia Cylinders of the Tube Type

(Usually in prone position when in service, but may be stood upright or in an inclined position.)

Physiologic Effects of Ammonia

Ammonia is not considered a poisonous gas, but due to its high solubility in water, it does have a very irritating action on the mucous membrane of the eyes, nose, throat and lungs. Fortunately, since its sharp, pungent odor serves as a warning signal, very small concentrations of ammonia in air are readily detected.

The following table shows the physiological response to various concentrations of ammonia in air. (Henderson and Haggard.)

	Parts of Ammonia Per Million Parts of Air (By Volume)
Least detectable odor.....	53
Maximum concentration allowable:	
(1) For prolonged exposure	100
(2) For short exposure (to one hour).....	300–500
Least amount causing immediate irritation:	
(1) To the throat.....	408
(2) To the eyes.....	698
(3) Producing coughing.	1720
Dangerous for even short exposure (½ hour).....	2500–4500
Rapidly fatal for short exposure	5000 or more

Exposure to air containing small amounts of ammonia is not harmful, but breathing air containing from 5,000 to 10,000 p.p.m. of ammonia may cause sudden death from spasm or inflammation of the larynx. High concentrations of ammonia gas will cause severe irritation of the eyes and permanent injury may result if immediate remedial measures are not taken. Ammonia's high solubility in water causes it to irritate any skin surface where moisture has accumulated. The resulting NH_4OH is

caustic but far milder than caustic soda, of course.

Since liquid ammonia vaporizes readily and has a great affinity for water, it may cause severe injury to the skin by both freezing the tissue and subjecting it to the caustic action mentioned. The symptoms of such a burn are practically the same as those of a thermal burn. The skin can withstand a 2 per cent ammonia solution, but greater concentrations have an intensely irritating action, especially on those portions of the body subject to perspiration.

First Aid

Any person who has been overcome or seriously injured by ammonia should receive the following "First aid" treatment:

1. *Pending the arrival of a physician.* Remove affected person to a place where there is fresh air. Place the patient flat on his back in relaxed position. Keep the patient quiet and warm. If necessary, prevent chilling by wrapping in blankets and warming with hot water bottles. The patient should be guarded against exposure to draft, especially if perspiring freely, and should not be excited or exercised unduly.

2. Call physician.

3. If patient is unconscious, use prone pressure (Schaeffer) method of artificial respiration. In the event that a police or fire department rescue squad is involved, make certain that a *pulmotor or other mechanical means of resuscitation is not applied.* The use of such equipment may rupture the lungs of the patient.

4. *Nose and Throat Burns:* Rinse out thoroughly with water, then use a 2 per cent boric acid solution to rinse mouth and snuff up nasal passages. Urge the patient to drink large amounts of water or milk.

5. *Eye Irritation:* Hold the lids open and pour water, then 2 per cent boric acid solution over the eyeball. After thorough rinsing in this way (at least 5 minutes) put two drops of liquid petrolatum in each eye.

6. *Skin Burns:* Remove ammonia-soaked clothing. Rinse thoroughly with water. *Light burns* may be swabbed with a solution of picric acid or carron oil. *If the burn is deep or sensitive picric acid* or carron oil should not be used. In such cases wash well with water, cover with boric acid compresses and keep moist until physician arrives. Recent medical research has shown that tannic acid is very efficient for treating burns and if desired, a freshly prepared 5% solution of tannic acid in sterile water may be used instead of boric acid for the compresses. The tannic acid solution should not be allowed to come in tontact with the inner surfaces of the eyes as harmful results may follow.

All users of ammonia should have a first-aid cabinet containing the necessary supplies required to properly treat ammonia injuries.

BOTTLE TYPE CYLINDER

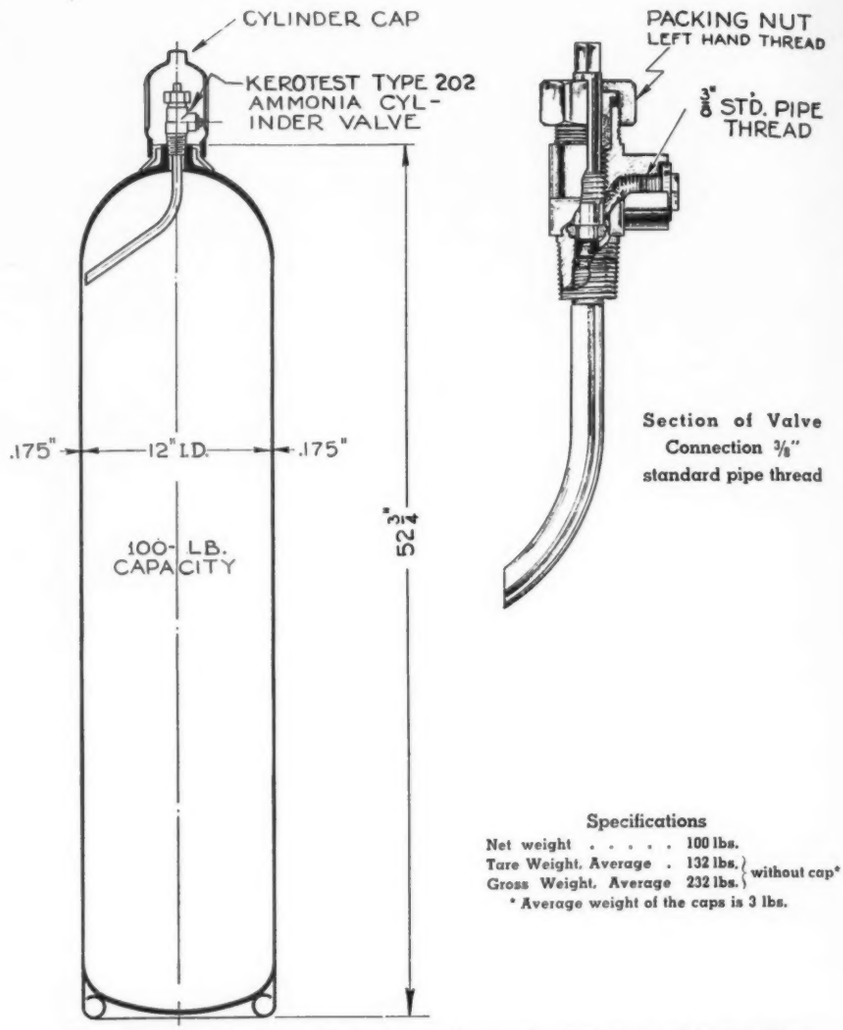

CYLINDER CAP
KEROTEST TYPE 202 AMMONIA CYLINDER VALVE
.175"
12" I.D.
.175"
52"
100-LB. CAPACITY
PACKING NUT LEFT HAND THREAD
3/8" STD. PIPE THREAD
Section of Valve Connection 3/8" standard pipe thread
Specifications
Net weight . . . . . 100 lbs.
Tare Weight, Average . 132 lbs. } without cap*
Gross Weight, Average 232 lbs. }
* Average weight of the caps is 3 lbs.

Fig. 5—Dimensions and Weights of Ammonia Cylinders of Bottle Type

(Available in 100 lb. capacity only. Always in upright position in service; has advantage of requiring less floor area, greater ease in handling, storing and placing in service.)

Posted on the cabinet should be the names of various physicians with their addresses and telephone numbers.

Summary (Some Do's and Don'ts)

1. Handle cylinders carefully. Do not drop.

2. Cylinders should be stored in a cool dry place away from sources of heat and protected from continued dampness. Storage near radiators or steam pipes may raise the pressure of the gas to a dangerous point while dampness may cause excessive corrosion.

3. Keep cylinder caps and valve plugs in place when cylinders are not in use.

4. Weigh cylinders, including caps, before connecting and check this weight against the gross weight shown on tag.

5. Open valve slowly and *only with the special wrench provided.* (Before opening valve, read instruction tag attached).

6. Keep ammonia gas mask available for individual authorized to act in cases of emergency.

7. In case of leaks, remember that gaseous ammonia is lighter than air and rises. Also, that it is very soluble in water.

8. Cylinders should not be exposed to temperatures exceeding 110° F.

9. Use extra heavy steel piping and ammonia valves for service lines. Copper and copper alloys should *not* be used.

10. Persons overcome by ammonia should be removed from the affected area, kept warm and given first aid treatment pending the arrival of a physician.

[*If the reader has any questions which do not seem to have been answered in this article, or has a special problem in connection with ammoniation or the handling and feeding of ammonia, the authors agree to try to supply additional information if requested, either direct or through "Water Works and Sewerage."*—ED.]

"WATERBUGS vs. JITTERBUGS"

Or

The Difference There Is Of

By ROLAND J. LEVEQUE
Superintendent of Filtration
FREDERICKSBURG, VIRGINIA

AS the philosopher says, "There is a Time and Place for Everything." We, however, not being interested in "everything" at the moment, shall consider the "Time and Place" in their relation to the writing of this article. For example, if Time was any scarcer than it is, this article would never have been written; if there was no Place for its publication, you would have been spared the ordeal of reading it. (Or *will* you read it?)

Time and Place, therefore, are inextricably bound together and we will consider the two as one. Besides it's cosier that way. Inasmuch, as the Time has about arrived for the singing, of my "Swan Song" as a Filter Plant Superintendent, Ye Ed. of a certain magazine has suggested that "Now is the Time to write my farewell article, and the Place, for its publication . . . uh, huh, you guessed it . . . the pages of 'Waterworks and Sewerage.' And, what's more, he has picked the topic, so this is neither the Time nor Place to discuss anything other than orders dictate. And this is what comes of army training."

The soldier has his manual of arms, the policeman his book of regulations; while I, an ex-marine, have a globe, anchor and eagle tattooed on my chest, to say nothing of a fine zeal for experiment which if followed wholeheartedly would probably land me in the can . . . but that's another story. Way back, during World War Days, when the U. S. was fighting to make the world safe for the Demmycrats, I (and a lot of others) helped win the war by *not* going to France. "The Marines have landed and have the situation well in hand," had been heard around the world. In fact I had the situation so well in hand "over here" that my commanding officers felt there was no need of my becoming further involved in situations "over there."

To make matters more difficult, I had fallen in love with a certain "Virginia Creeper" who possessed an irresistible Southern drawl, which was new to this pair of Yankee ears. They managed to clean up in France without my assistance and in due time I was discharged—with honor

"Rollie"

—(and not without pleasure, I may as well admit). I seemed to be "finis la guerre" . . . or so I thought. After about a year of trying to earn a living, I suddenly awoke one morning to find myself married to the "Southern Accent" which score 1,000 points for the other side and landed me squarely behind the eight-ball. Now don't get me wrong, this simply means, if you know your arithmetic, that when 1 and 1 get married, it equals 2, with eventually 1 to carry.

I Land a Job That Intrigues Me

(The curtain is lowered at this point to denote a lapse of memory and, anyway, what transpired during this period is nobody's business!) Oh, all right, then, if you must know, I played saxophone and violin in vaudeville, radio, and hotels, which proves that this heel had a soul. We were doing swell when along came Vitaphone (talkies to you) and canned-music began to make inroads on the employment of legitimate musicians. Seeing the handwriting on the wall, I got out before the crash and sallied southward to Richmond, Virginia. To make a dull story duller, along about 1927 the City of Fredericksburg (my Southern Accent's hometown) built a filtration plant. Having read a Chemistry book once, I applied for the position of superintendent of the new plant. And, believe it or not, I was selected (probably because of my saxophone and fiddle-playing), the obvious deduction being that any man who understood "Jitterbugs" would not find "Waterbugs" much of a problem. I might add that experience has revealed no marked difference between these two species of bugs. Taken alone or en masse (mussed up) the initial irritation multiplies as the square of the number present, or, to put it more simply, they get gosh danged annoying.

For all purposes and intent, I was determined to confine my talents to the operation of this new filtration plant. So, I became the best customer the correspondence schools ever had, in that, they were able to declare a dividend from sales of these courses to me. Every time I finished one, the townfolks would turn out, gathering at the post-office to see me receive another diploma.

Now ye who labor so diligently in filterplants, must know from experience that ours is more a labor of love than financial remuneration. In my case, had they paid me what I was worth, I would have starved to death, on the other hand, had they paid me what I thought I was worth, it would have entailed an extra tax levy. So we compromised . . . my salary was just about like yours, and yours, and yours! Unfortunately, or fortunately, water bills were not paid to my office, therefore, I was deprived of any opportunity to bring home samples from the city treasury. By this time you should be catching on . . . I loved my work, and also Fredericksburg; and, in addition, a lot of other things that make life pleasant, but which can only be bought with money.

A Landlord Who Didn't Believe in Love

One of the items which my salary had to provide may be expressed algebraically thus:

$$A+\frac{X}{B}\times\tfrac{1}{4}C=X\ (H_2O)$$

Let A equal Apartment, B the monthly rental and C the landlord's chance of collecting his rent, *on my salary*. By inversion we get:

$$A=\frac{X}{B}\times\tfrac{1}{2}\ (H_2O),$$

which is no help, and inversion always makes us dizzy anyway. Solved, the equation gives us

$$X=5\times\frac{\tfrac{1}{4}BC}{?}$$

and a headache.

"X" of course represents the "spot" which the landlord insisted having his money on, or in other words some $$$ more a month than I could afford. Yep, I had to supplement my income. There was no alternative but to shoo the moths out'n my saxophone, tune up the "A" on my fiddle and acquire myself an orchestra. This, dear readers, was the beginning of my Dr. Jekyll and Mr. Hyde existence—a protector of health by day—an exterminator of water-bugs; by night, a sinister creature, menacing health—a dispenser of "Crippling Rhythms" which bred jitter-bugs by the score. Which brings us to the point of this story. (Um-m, we thought he'd never get to it!) Well, if you feel that way about it, this is as good a time as any to indulge in "The Pause That Refreshes." (Adv't.)

My Waterbugs and Jitterbugs

In dance halls and night clubs, Jitterbugs exhibit marked traits and characteristics which are closely akin to those displayed by waterbugs. For instance: Whipple says in his monumental text—"Algae samples may be preserved by adding a sufficient amount of 95 per cent alcohol to produce a concentration of 75 to 80 per cent in the sample." (I can assure you that many a jitterbug has been pickled in a not dissimilar manner.)

Whipple further states, "Many of the organisms, particularly the protozoa, are destroyed during transportation to the laboratory, but some of the carcasses can be recognized even after partial destruction." (Many of the Jitterbugs, particularly the species "Alcoholic," are blottoed during transportation to the night club, but some of the carcasses are recognizable as they protrude partially from beneath the tables.)

All of you are familiar with laboratory procedure, therefore, I am wondering if you will detect any similarity in the following technique for determining to what species the Jitterbug belongs?

1.

Jitterbug sample is shaken vigorously in a Susie-Q manner.

2.

No need to flame the mouth of bottle used in this particular test before removing stopper.

3.

Directly from the bottle, suitable amounts of "Giggle-Soup" are transferred (planted) in Jitterbug.

4.

Jitterbug is rotated immediately to insure thorough distribution of gin through Jitterbug.

5.

"Red Hot Mama" plus a Glenn Miller orchestration of "Little Brown Jug" furnishes all heat necessary for proper incubation.

6.

At end of incubation period, examine Jitterbug and record results as follows:

(a) Absence of Gas.—If no gas has been produced at the end of short incubation period—re-incubate Jitterbug with more Red Hot Mama, plus Wyoming Ketchup and a swing arrangement of Tuxedo Junction.

(b) Formation of Gas. — When large volume of gas (10 per cent or more) are produced, burping will be evident and Jitterbug will begin to shoot off mouth about how good Benny Goodman is (pH 8.9) and how lousy the local band is (pH 4.7).

[All this abuse because we didn't play 'em all hot, but chose to honor the request of a visiting gray-haired waterworks man, to play a nice waltz or two.]

And, to New Efforts

So; that's my story, folks, now that opportunity in new fields has beckoned and I am shortly retiring after 13 years of interesting work in a small city performing the strange combination of Water Plant Superintendent and Orchestra Maestro to make ends meet a little more comfortably—incidentally, to get a better perspective of the meaning of the good Public Relations—by day and by night. But, with it all, we have never yet been tempted to turn our Filter Plant into a night club nor have we let Jitterbugs interfere with our attention to Waterbugs.

Although I am leaving the operating end to become associated with the developmental and commercial side* of the water works and sewerage fields, it is pleasant to realize that I will not be losing contact with the many friends and admired acquaintances made during these past thirteen years. So, here's hoping that in my new job I'll be seein' you at some of the meetings and conventions.

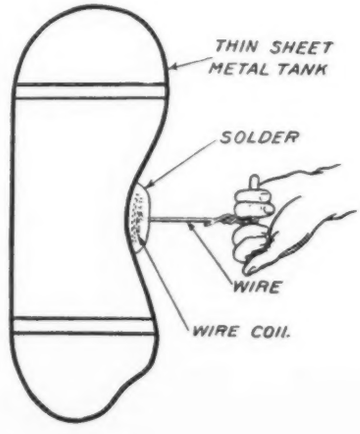
*[As announced in our February issue, "Maestro" Leveque is leaving Fredericksburg to become associated with the Laboratory and Chemical Supply House of Phipps and Bird, Richmond, Va. We wish for him, and those recognizing his abilities, new successes.

Correspondence Schools—take note; another of your "self-made" graduates may some day also rate his picture in your *Saturday Evening Post* ads, as has recently a certain Colonel—R. from Pittsburgh, whom many of our readers also know.—Ed.]

A TANK STRAIGHTENING KINK*

The accompanying sketch shows a method that may be used successfully in straightening thin dented or collapsed tanks. If a straightening rod can be used on the inside for reaching the dented spots, or if it is practicable to apply internal water or other pressure for forcing out the dents gradually, the method illustrated may require more time and effort and is not recommended. But, there sometimes is no other method. Also this scheme may be used in conjunction with assisting internal pressure.

Proceed as follows: Make a coil on the end of a wire similar to that shown in the sketch and solder it onto the tank at the dented place. When solidly attached pull with one hand and simultaneously pound around the outside of the dent with a soft hammer with the other hand. The dent will usually come out without any difficulty.



After straightening, the solder is easily melted off and the same procedure is applied to the next dent, if there is another.

*Contributed by W. F. Schaphorst, M.E., Newark, N. J.

[*This item brings back recollections of cases on record in which a sudden main failure or main emptying for repairs resulted in a negative pressure which caused domestic hot water tanks of thin copper to collapse.*

Then while the distressed owner of the "ruined" tank was bemoaning his loss the collapsed tank resumed its original form when the water pressure was restored.—Ed.]

WHAT CONSTITUTES WARRANTY OF WATER ON PART OF WELL DRILLER?

By LESLIE CHILDS
INDIANAPOLIS, INDIANA

AS a general rule, there is no implied warranty on the part of a well driller in respect to the amount or quality of water a given well will produce. On the other hand, where a driller expressly warrants or guarantees that a well will produce water of a certain quantity or quality he will of course be bound thereby.

The question then of what may constitute such a warranty is deserving of careful attention by drillers and those for whom the well is being drilled. The use of the words "warranty" or "guaranty," in making representations, is not essential here; for, if a driller only affirms as a fact that if allowed to do certain drilling a well of a given quality will result, this may constitute a warranty, if relied upon by the other party, whether the driller intended it as such or not.

Obviously, here is a point that well drillers, and all concerned, may well have in mind when making representations or statements relative to this phase of their work when contracts are being negotiated. And, as an illustration of judicial reasoning in unscrambling a situation of this kind, the following case may be reviewed with interest and profit.

A Case at Point

In the case at point, the defendant contracted to drill an eight inch well for the plaintiff at a price of six dollars a foot. Neither party contemplated that it would be necessary to go beyond 150 feet, as it was thought an ample supply of water would be reached at that depth. The contract was in writing and did not contain any "warranty" whatsoever in relation to obtaining *usable* water.

The defendant contractor started drilling under this contract and drilled 295 feet. Water was obtained but it was both deficient in quantity and unusable, having an odor of "rotten eggs and sulphur." The parties then discussed the advisability of going deeper. And, at this point, the plaintiff claimed that the defendant expressly warranted an adequate supply of usable water if allowed to drill deeper to St. Peter's sand, below the deficient lime rock.

Warranty Claimed

Anyway, with plaintiff's consent, defendant continued to drill until he had reached the 988 foot depth. The water obtained was discolored, and offensive in odor and not usable. Plaintiff up to now had paid the defendant $4,867, and brought the instant action to recover same on the ground, among other things, that defendant had breached his warranty to produce a well of usable water. The defendant denied that he had made any such warranty. This, then, was the principal issue between the parties at the trial of the case.

In support of his contention of a warranty, plaintiff introduced letters of the defendant in which the latter, in part, said: "If you will let us go into that [St. Peter's sand] about 75 or 100 feet, you will then have a first class well, because that rock is water-bearing rock . . . if we hit the sand rock that will give you soft water that you can use for all purposes and make you an up-to-date well."

Further, plaintiff introduced evidence that at the 295 foot depth the defendant said: ". . . St. Peter's sand rock, if you go to that you will get soft water and it will be the very best of water, and it will give you as good a well as you can get." . . . That "if allowed to go to St. Peter's sand, that there would be no question of the quality and quantity of the water."

Defendant on his part denied that he had told plaintiff that he would get *good* water if permitted to continue drilling. In the face of this conflict in the evidence, the trial court submitted the question to a jury. The latter found that defendant had expressly warranted the water, and that the water obtained was not reasonably usable. The trial court thereupon gave judgment that the plaintiff should recover the $4,867 paid the defendant. The defendant appealed, and the higher court in reasoning on whether the evidence supported the finding that defendant had warranted the water, in part, said:

Reasoning of Appellate Court

"Thus, although neither the word 'warranty' nor 'guaranty' was actually used by the defendant in the statements which he made to plaintiff to induce him to permit him to drill beyond the 295-foot depth, there was evidence of sufficient affirmation by the defendant that he would obtain 'good soft water' for plaintiff to continue, upon the latter's reliance thereon, as binding an express contract of warranty as if the defendant had used the most formal and unequivocal language on the subject . . .

"Consequently there was an issue for the jury as to whether the defendant guaranteed that, if he were permitted to drill the well to St. Peter's sand rock, reasonably usable water would be procured at that point; and the jury's affirmative finding on that issue was warranted by the evidence on that subject. . . ."

Then turning to the question of the amount that plaintiff should be allowed to recover, the court continued:

"However, as that express guaranty was not made until 295 feet had been drilled without any such guaranty, it was not applicable to that portion of defendant's work. Consequently, . . . the defendant is entitled to retain, . . . compensation for drilling those 295 feet at the agreed rate of $6 per foot, or a total of $1,770.

"Deducting that sum from the total advancements of $4,867, leaves $3,097 as the amount which plaintiff is entitled to recover herein, and the judgment must be modified accordingly . . . Judgment . . . affirmed as modified." (265 N.W. 182.)

Conclusion

So ended the case. And, as an illustration of words and representations that may constitute a warranty or guarantee of water on the part of a well driller, this case is hard to beat. Here, as we have seen, the defendant driller did not use the word "warranty" or "guaranty" in any of his statements, in respect to obtaining usable water if allowed to go further with the drilling.

But the evidence as to what he did write and say, as has been outlined heretofore, was held sufficient under the facts to take the question of whether it constituted a warranty to the jury. And, as is usual in cases of this kind, the findings of the jury on that question were upheld by the appellate court. A nice case, indeed, on the point involved, and one that well drillers, and parties for whom wells are being put down, may well have in mind when drilling contracts are being negotiated.

Let's Not Get Overly Excited Concerning Priorities

THESE days we hear much concerning priorities and rulings from the office of Production Management in Washington concerning priorities.

Not alone has there been control of supply and distribution to private enterprise, but public enterprise has come under the same surveillance.

That such is the case has proved disturbing to a number of municipal administrators, and to some water works managers who recently have had brought to their attention that the Priorities Division of O.P.M. has ruled that, to issue a blanket (general) priority order to public or privately-operated water works, can not be justified on existing grounds.

This matter of water works priorities got conspicuously into the technical press in two instances last month. One of our contemporaries printed a letter from a mayor of a medium-sized city to the O.P.M., requesting issuance of a blanket priority order for water works materials. Alongside was printed the reply thereto, by the Director of Priorities, which related the status of municipal water works as appraised by this Division of O.P.M. and refused the mayor's request for a blanket priority ruling. This development proved the basis for an editorial in the same issue.

Noting the possible effects and results from the denial of general priority authorization for materials required by a water supply system to meet an emergency situation, and pointing to the belief that the actions taken in Washington are not for the best interests of the country, the editorial closed with a fervid suggestion that a concerted endeavor be made to have the officials in Washington change their attitude on priorities for emergency water works materials.

The editorial cited has seemingly created an unnecessary amount of concern in the minds of a number of water works authorities, as came into evidence at the recent meeting of the New England Water Works Association in Boston on February 20th. There a member, in commenting on the questionable actions from Washington, made reference to the editorial and the letters in question, with a degree of concern that brought forth an impassioned plea for the passage of the following resolution:

> "WHEREAS, The maintenance of a public water supply is essential to any community, the members of the New England Water Works Association are of the opinion that in case of emergency, as in accidents to pumping stations, reservoirs, filter beds, standpipes, and breaks in pipe lines; orders for repair materials be given equal priority with defense materials, such orders, to be valid, to be attested by authorized officials connected with the water works departments, either public or private, in such communities so ordering."

That this member, a manager of a privately owned water works, was not alone in his concern over the situation was attested by the fact that only one voice was raised questioning whether there was *real* need for such a resolution at this juncture; whereas, those not easily perturbed or excited water works superintendents of New England, there assembled, were sufficiently perturbed to vote the resolution unanimously.

As to the results from the resolution sent promptly to Washington, here follows the opinion from the Director of Priorities, unchanged from that already published. However, a new *assurance* is found in the reply, which courteously acknowledges the resolution and then briefly but clearly states—

> "We are glad to have this information and wish to assure you that any specific requests arising from unforeseen circumstances will be given our careful attention."
>
> Sincerely yours,
> E. R. STETTINIUS, Jr.,
> Director of Priorities.

In looking back again at the copy of the letter from the Mayor of Cumberland, Md., suggesting to the same authority that all water works equipment and supplies, such as may be certified by the local governing body as emergency needs, be given equal priority with *all* defense orders, this request does appear to be asking for a blanket authorization which may come to abuse.

To the Mayor of Cumberland the Director explained the situation by stating—

> "I am sure you will realize, upon reflection, that existence of the vast body of priorities, as suggested in your letter, would not only slow down the operation of the manufacturers of pipes, valves, etc., but would dilute and make much less effective such priority orders as may be issued in cases where such issue is really essential.
>
> "In case you are faced with a specific case where you feel that priority is essential to the national defense, and will submit it to us with supporting data, we shall be glad to give it the most careful consideration."

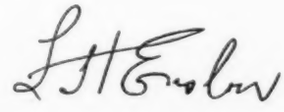
Our remarks made to the resolution here reproduced, were based on what we continue to believe the correct interpretation of Mr. Stettinius' explanation and reply to the Mayor of Cumberland. The Director seems to make it plain enough that where a city administration, or head of a water works deems priority essential it is only necessary to make the request, attended by supporting data, for the specific case to be given justified consideration. Please note that this means, in our humble opinion, just what it should—namely, a matter of each case, on its merits. This, too, seems quite amply confirmed in the Director's reply to the N.E.W.W.A., in which he goes a step further in giving *assurance* that "any specific requests arising from unforseen circumstances will be given careful attention."

In this connection it is of interest to consider a statement carried on an attention arresting blue insert appearing in the February number of the Journal of A.W.W.A. Written by Harry E. Jordan, Executive Secretary and Editor of the Association, the following is said under the caption *"Water Works and Priorities."*

> "Suggestions have been made that this Association attempt to obtain a general preferential ruling on behalf of water works which would entitle any water supply order to priority consideration. It is not clear that such general priority ruling on behalf of water supply is defensible. In any community where increased demand has resulted, or is about to result, from defense activities, the executives in the government department responsible for the added demand are in a position to obtain preferential treatment for orders placed by the water works superintendent in his efforts to meet the needs. Otherwise water supply orders now appear to be properly considered in the same class as any other type of public service material.
>
> "Water supply executives who have reason to disagree with this opinion are invited to record their opinions with the Association."

This memorandum to members received special circularization to the Directors and other officials of the Association and also the Water and Sewage Works Mfgrs. Ass'n. With the passage of better than 30 days since its distribution there has developed not a single objection of record.

Looking ahead, ordering, and being prepared, is one thing; neglect, delay, and procrastination, quite another. To institute blanket priority is to retard the first and foster the last.



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MEETINGS SCHEDULED

March 20—BOSTON, MASS. (Hotel Statler)
New England Water Works Association. Secretary, Frank J. Gifford, 613 Statler Bldg., Boston, Mass.

March 20-21—TRENTON, N. J. (Stacy-Trent Hotel)
New Jersey Sewage Works Ass'n (26th Annual Meeting). Treas., Paul Molitor, Jr., Box 374, Morristown, N. J.

March 21-23—YUMA ARIZONA
Arizona Sewage & Water Works Association. Sec'y-Treas., F. C. Roberts, Jr., State Sanitary Engr., Board of Health, Phoenix, Ariz.
(Joint Meeting with)
California Water Works Association and
California Sewage Works Association.

March 27-28—SYRACUSE, N. Y. (Hotel Syracuse)
New York Section A.W.W.A. Secretary, Rollo K. Blanchard, Neptune Meter Co., 50 West 50th St., New York, N. Y.

April 2-4—BOSTON, MASS. (Hotel Statler)
New England Sewage Works Association. Sec'y-Treas., LeRoy W. VanKleeck, State Dept. of Health, Hartford, Conn.
(Joint Meeting with)
New England Health Institute and **New England Water Works Association.** Secretary, N.E.W.W.A., Frank J. Gifford, 613 Statler Bldg., Boston, Mass.

April . .—SALEM, N. J. (Salem Country Club)
South Jersey Ass'n Water Superintendents. (Annual Meeting.) Secretary, Walter Spencer, 2707 Bethel Ave., Merchantsville, N. J.

April 7-10—MADISON, WIS. (University of Wisconsin)
Sixth Short Course For Water Works Operators. (Sponsored by Wis. Municipalities & Wisconsin Section A.W.W.A.) Eldon R. Dodge, Univ. of Wisconsin, Madison.

April 9—WATERVILLE, ME.
Maine Water Utilities Association. Secretary, Earle A. Tarr, Winthrop, Maine. (Future scheduled meetings—June 11, Framington; August 13, Lubec; October 18, Kittery; December 10, Bangor.)

April 9-11—COLUMBIA, MO. (University of Missouri)
4th Annual Short Course for Water Works Operators. (Sponsored by Missouri Water and Sewerage Conference and the Univ. of Missouri.) J. A. Logan, Ass't Prof. C.E., University of Missouri, Short Course Director.

April 14-16—FAYETTEVILLE, ARK. (University of Arkansas)
Arkansas Water & Sewage Conference. Secretary, Harrison Hale, 114 Chemistry Building, Fayetteville, Ark.

April 23-25—BALTIMORE, MD. (Lord Baltimore Hotel)
American Society of Civil Engineers. Spring Meeting. (Sessions of Sanitary Engineering Div. April 24, with afternoon inspection of Baltimore Treatment Works.) Secretary, George T. Seabury, 33 West 39th St., New York, N. Y.

April 24-25—INDIANAPOLIS, IND. (Hotel Antlers)
Indiana Section A.W.W.A. Secretary, Herman G. Horstman, Sup't Water Distribution, Public Service Co. of Indiana, Traction Terminal Bldg., Indianapolis, Ind.

*April 28-30—QUINCY, ILL. (Lincoln Douglas Hotel)
Illinois Section A.W.W.A. Secretary, H. E. Hudson, Jr., Experimental Filter Plant, 6843 Oglesby Ave., Chicago, Ill.

(*Represents a change from earlier published dates of Apr. 21-23.)

May 8-10—SEATTLE, WASH. (Olympic Hotel)
Pacific Northwest Section A.W.W.A. and
Pacific Northwest Sewage Works Association. Secretary, Fred Merryfield, Oregon State College, Corvallis, Ore.

May 12-14—CHARLESTON, S. C. (Fort Sumpter Hotel)
Southeastern Section A.W.W.A. Sec'y-Treas., B. P. Rice, R. F. C. Healey Bldg., Atlanta, Ga.

May 15-16—CINCINNATI, OHIO (Gibson Hotel)
Ohio Section A.W.W.A. Secretary, T. R. Lathrop, State Department of Health, Columbus, Ohio.

*May 23-24—MISSOULA, MONT. (Hotel Florence)
Montana Section A.W.W.A. Sec'y-Treas., H. B. Foote, Director, Div. of Water and Sewage, State Board of Health, Helena, Mont.
(*Represents a change from earlier published date of May 16.)

June 22-26—TORONTO, ONT. (Royal York Hotel)
American Water Works Association. Annual Convention. Secretary, Harry E. Jordan, 22 E. 40th St., New York, N. Y.

June 22-26—TORONTO, ONT. (Royal York Hotel)
Canadian Section A.W.W.A. (Annual Meeting). Secretary, A. E. Berry, Ontario Department of Health, Parliament Buildings, Toronto, Ont. (Meeting Jointly with Annual Convention of A.W.W.A.)

Aug. 7-9—ERIE, PA.
Western Penna. Section A.W.W.A. Secretary, E. P. Johnson, 418 Flannery Bldg., Sta. 13, Pittsburgh, Pa.

Sept. 1-3—STATE COLLEGE, PA. (Pa. State College)
Pennsylvania Water Works Operators' Association. Sec'y-Treas., I. M. Glace, 22 South 22nd Street, Harrisburg, Pa.

Sept. 3-5—STATE COLLEGE, PA. (Pa. State College)
Pennsylvania Sewage Works Association. Sec'y-Treas., Bernard S. Bush, Kirby Health Center, Wilkes-Barre, Pa.

Sept. 23-26—BOSTON, MASS. (Hotel Statler)
New England Water Works Association (Annual Convention). Secretary, Frank J. Gifford, 613 Statler Building, Boston, Mass.

Sept. 24-26—GRAND RAPIDS, MICH. (Hotel Pantlind)
Michigan Section A.W.W.A. Secretary, Maurice N. Gerardy, Department of Water Supply, Detroit, Michigan.

Oct. 13-16—FORT WORTH, TEXAS
Southwest Section A.W.W.A. Secretary, L. A. Quigley, Sup't City Water Works, Fort Worth, Texas.

Oct. 14-17—ATLANTIC CITY, N. J. (Convention Hall)
American Public Health Association (70th Annual Meeting). Executive-Secretary, Reginald M. Atwater, M.D., American Public Health Ass'n., 1790 Broadway, New York, N. Y.

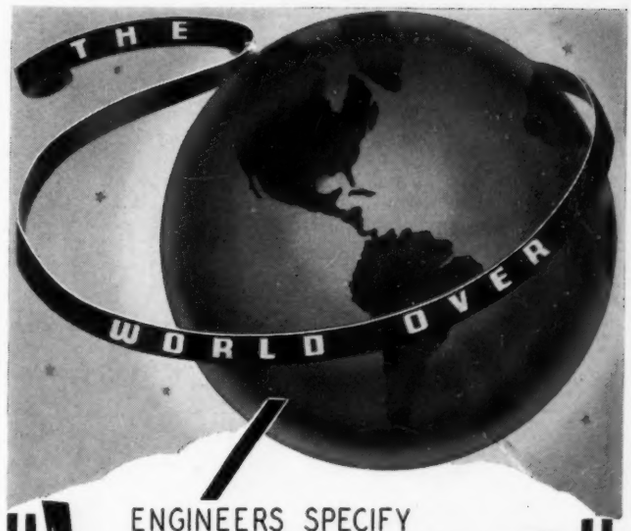
Oct. 20-22—CEDAR RAPIDS, IOWA
Missouri Valley Section A.W.W.A. Secretary, Earl L. Waterman, Prof. of Sanitary Engineering, Univ. of Iowa, Iowa City, Ia.

Oct. 22-25—FRESNO, CALIF. (Hotel Fresno)
California Section A.W.W.A. Sec'y-Treas., G. E. Arnold, San Francisco Water Department, Millbrae, Calif.

Oct. 22-25—NEW ORLEANS, LA.
American Public Works Association. Ass't Director, N. Hebden, 1313 East 60th St., Chicago, Ill.

Nov. 3-5—HIGH POINT, N. C. (Sheraton Hotel)
North Carolina Section A.W.W.A. and
North Carolina Sewage Works Association. Secretary, R. S. Phillips, Box 1170, Durham, N. C.

Nov. 6-7—BALTIMORE, MD.
Four States Section A.W.W.A. Secretary, Lloyd Nelson, U. S. Pipe and Foundry, Broad and Chestnut Streets, Philadelphia, Pa.



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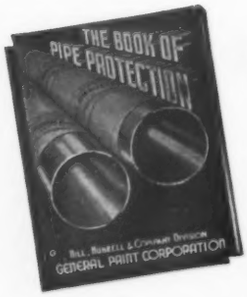

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LITERATURE AND CATALOGS

"Perchloron" is Pennsylvania Salt Co.'s newest bulletin devoted to the high-test hypochlorite of the same name.

This publication is in reality a hand-book on the hypochlorination of swimming pools, water, sewage, etc., with "Perchloron." It begins, as it should, by telling what "Perchloron" is, and how it is made; how it can contain 70 per cent or better of available chlorine. No secrets are held back in this "tell-all" brochure. It gives the best known methods of preparing solutions from the free-flowing powder, and dosage charts are provided for facilitating feeding calculations. Methods and equipment for feeding the solution involve amply illustrated descriptions. Procedures for determining residual chlorine are given. The section, "Perchloron in Water Purification," reveals the many applications for which hypochlorite solutions are especially suitable, embracing small supplies; emergency usage; main and reservoir disinfection; algae control; sterilizing and purging filter beds; treatment of wells. The section, "Perchloron in Sewage Treatment," deals with routine disinfection in small plants; odor control; BOD reduction; use for aiding chemical precipitation; retarding oxygen depletion and slime growth control in small streams; correcting activated sludge bulking; relief of ponded trickling filters or sand filters. Then follows the section, "Perchloron in Swimming Pool Sanitation," and another on "Applications in the Food and Beverage Industry." The last four pages are devoted to illustrated descriptions of the various styles of hypochlorinators for feeding hypochlorite solutions that are offered by Wallace and Tiernan Co. of Newark, N. J., and % Proportioneers, % Providence, R. I. A neat mixing tank, for dissolving "Perchloron" or other hypochlorites, and making up stock solutions, is illustrated and described—a unit which has been specially designed by Pennsylvania Salt. If interested in a copy of this useful hand-book write Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia, Pa.

"Dresser History and Service" are the subjects of a very high-quality illustrated brochure of 24 pages just published by the Dresser Manufacturing Co. It is designed to take readers behind the scenes of this company and give them an insight into its history, its products and the services rendered in the gas, oil, water and sewage field. Dresser, starting in 1880 with a single item that proved to be an excellent pipe coupling of novel design, has since 1932 purchased Bryant Heater Co. of Cleveland, Clark Bros. Co. of Olean, N. Y. (engines) and the Pacific Pump Works of Huntington, Calif., all now being operated as divisions of Dresser Co. and constituted as interrelated units.

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mousetrap" of the time—Dresser's Flexible Coupling, which established the merits of rubber gasket rings in pipe jointing. For a copy of this brochure write Dresser Mfg. Co., Bradford, Pa.

"Radial-cone Bottom Tanks" are featured in a new 20 page impressively illustrated bulletin just published by the Chicago Bridge and Iron Co. The numerous pictures of elevated tanks of the radial-cone bottom design represent typical installations, each of which is briefly described and some particular feature emphasized. The smallest unit shown is a 125,000 gallon tank; the largest is one of the three 2,000,000 gallon tanks of Buffalo. In this marked range of sizes the most economical use of the cone-bottom design appears to be for tanks of 750,000 gallons capacity and larger. However, many have chosen the design for smaller units because of the advantage of appearance and the low head range from full to empty which the design permits. The pictures provide a ready means of comparing the appearance of the newer cylindrical columns against the structural steel tower, the cone vs. ellipsoidal roofs, spiral stairs vs. straight ladders, etc. It makes a highly interesting and informative catalog of pictured elevated tanks for anyone considering the most appropriate style and design of a tank for a given situation and service functions. For a copy of "Radial-cone Bottom Elevated Tanks" write Chicago Bridge and Iron Co., 332 South Michigan Ave., Chicago, Ill.

"Inertol Coatings and Enamels" are given a boost by a number of engineers and plant managers through a group of testimonial letters selected for publication in a folder from the Inertol Co. of New York, which boasts 40 years of "Inertol" history and satisfied users. The folder describes each of seven distinctive Inertol products used as protective coatings for water and sewage works structures and equipment; such being, Standard Inertol (a coal tar base enamel for cold application); Metalead Primer; the Ramuc Enamels, in colors, for dry or damp walls, floors, and ceilings; the Glasoflex Enamels for metal structures and equipment; Incolite Enamel, which is used as a paint to meet the less severe conditions; Torex Enamels for the most severe submerged corrosion, where acidity or alkalinity exceeds the range pH 5 to 9. All of the several enamels named are available in a number of colors. For a copy of Folder 588 and further information, write the Inertol Co., Inc., 401 Broadway, New York City.

"A Course in Meterology" is being offered by Ford Meter Box Co. of Wabash. A little booklet presents "Six Easy Lessons in Meterology"—and, believe-it-or-not, Meterology is defined by Mr. Webster as "the science or art of using meters" or "the husbandry of meters, their installation and maintenance," and "the economics of meter setting, treating of the worthwhileness of proper attention to meter installations and effective testing to maintain revenue." At least that is what the Ford booklet gives us as a fact, and we take it to be so. In any event, "Meterology" has rather prevalently been much more an art than a science. To put more science into the art along comes Ford of Wabash with a number of units which lead in this direction. The "Six Easy Lessons" begin with (1) Housing, and then proceed to treat of (2) Availability; (3) Appearance; (4) Protection; (5) Convenience; (6) Testing and Maintenance. The booklet at a quick glance shows by pictures what part each of 13 of Ford's "aids to good meterology" takes in the six lessons. For a copy of "Meterology" or Ford's worth having brochure "Testing Water

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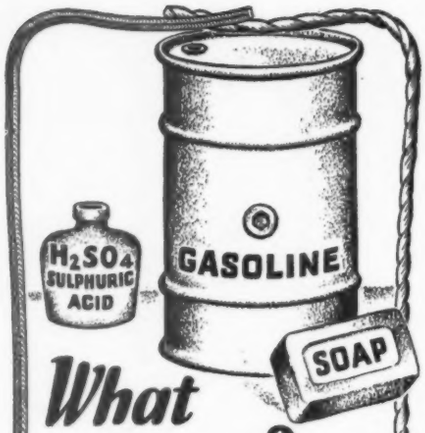

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City..... State.....

Meters—Why and How" (1941 Edition now under production), write The Ford Meter Box Co., Wabash, Indiana.

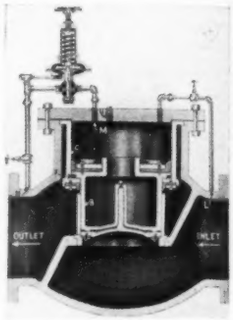
"The Pioneer" for February is another issue particularly interesting to readers of "Water Works and Sewerage." February contents include a description of methods employed by New York City's "water leak detectives," who have traced leaks to successfully reduce water losses to the extent of 60,000,000 gallons daily. Other brief articles of interest in this issue tell of "The First Water Works System of America"; How Poughkeepsie Pioneered in Chlorination"; "Water and Sewage Plans—Defense Needs of First Rank"; New York City's New Master Sewage Disposal Plan"; "How a Water Tower Boosted Paper Mill Sales"; "Engine Performance Improved by Adding Soap to Oil." **"The Pioneer"** is published monthly for complimentary circulation by Electro Bleaching Gas Co. If you are not receiving it, we can recommend that you tell "E. B. G.," 60 E. 42nd St., New York City.

"Hills-McCanna's Centrifugal Chemical Pumps are the subject of a bulletin from Hills-McCanna Co. of Chicago. These pumps have for years been widely used in the industrial field for handling acids, ferric chloride and other corrosive liquids. To eliminate efficiency losing wear of moving parts having close clearances, the full load of the impeller units is carried on ball-bearings which preclude thrust in any direction. Special consideration has been given the stuffing box design; such being of the split screw type, which cannot be tightened on a shaft scoring angle. It is easily repacked and has no bearing behind the packing. These pumps are produced in a variety of alloys to suit the specific need best. For further details write Hills-McCanna Co., 2349 Nelson St., Chicago.

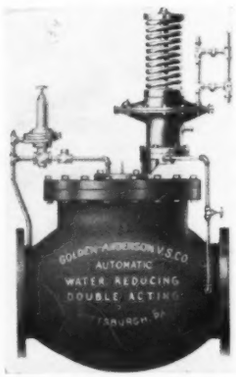
"Taste and Odor Control" is the title of one of Wallace & Tiernan's newest Technical Publications. This one features "Break-Point" chlorination—a form of superchlorination, the efficacy of which can be foretold by simple testing to reveal the minimum effective dosage while at the same time precluding waste in the nature of excess residual chlorine. The discussion of this process, which has during the past year become so prevalently employed as the most definite taste and odor control procedure that has become available, is really a presentation by A. E. Griffin of basic

AUTOMATIC VALVES

Golden-Anderson reducing and sustaining valves are the invariable choice of plant operators who pride themselves on low operating and maintenance costs.



This valve is virtually two valves in one, a regular water reducing valve as well as a reverse flow check valve. Will not dissipate water back into suction in case of pump shut-down.



New CATALOG

The demand continues from engineers and plant operators for helpful, informative new-type catalogue. Better write for your copy today.

GOLDEN-ANDERSON VALVE SPECIALTY CO.
Fulton Building Pittsburgh, Pa.

principles—we might say the A, B, C's of the process. It presents the different behavior of waters of 4 typical types; and becomes useful, therefore, as a guide to those wishing to test the efficacy of "Break-Point" chlorination in the laboratory before going into plant scale operations. Any interested reader who may have been considering the possibilities of this new super-chlorinator method will do well to make a careful study of W. & T.'s Technical Publication No. 207. Address Wallace & Tiernan Co., Inc., Newark, N. J.

"Hyde-Ro Rings" are the rubber joint packing rings developed by Ralph H. Hyde, supt. and manager of the Campbell (Calif.) Water Co. These rings serve to replace the ordinary insanitary jute or yarn, which had given him and many another superintendent and chemist much to be concerned about in the matter of harboring and growing bacteria. The four page folder pictures and describes the "Hyde-Ro" Rings and their application in a jointing operation. After driving the ring up to the bead in the pipe any desired joint compound or lead is poured behind it in the customary manner. The folder carries with it a price list of rings for 4 to 12 inch pipe. They are said to be inexpensive in the end, because their use saves labor, material, waste, and worry—the worry being the need for sterilization and the so-called after-growths which come from the bacteria nourishing jute and yarn. Mr. Hyde also has for the asking reprints of his articles describing the Hyde-Ro Ring, its use and advantages, which was published in the September, 1940, issue of the magazine. For further information write Ralph H. Hyde, P. O. Box 1, Campbell, California.

"The Copper-Tube Handbook" is not exactly new, but has only recently come to the attention of this reviewer. Some time previously we reviewed the very useful "Brass Pipe Handbook" published by the Copper and Brass Research Assn. The "Copper-Tube Handbook" is a companion publication issued by the same sponsor. In 44 pages of illustrated text the first few pages are devoted to the properties and behavior of copper-tubing—what we would term the "Eight Reasons for Considering Copper Tubing." For a copy of the "Copper-Tube Handbook" or the companion piece the "Brass-Pipe Handbook" write The Copper and Brass Research Ass'n, 420 Lexington Ave., New York City.

We Stopped Waste!

Royer converts sewage sludge cake into fertilizer at Norwalk, Ohio, sewage treatment plant.

Like the sewage treatment plant of many municipalities, Norwalk, Ohio, has used a Royer for some time to shred, mix, aerate and further dry sewage sludge cake so that it can be used for lawn top dressing and fertilizer. No more wasting this valuable product that is needed and wanted by parks, florists, golf clubs, cemeteries and estates.

Your sewage treatment plant, too, can eliminate the wasteful and costly destruction of sludge cake by incineration, burial or dumping with a Royer Sewage Sludge Disintegrator.

Royers shred sludge cake with a moisture content as high as 51%, further drying it, removing sticks, stones and trash and reducing the sludge to pea size particles that readily yield their fertilizing elements to the soil. Too, in the same operation, Royers mix-in enriching chemicals or thoroughly mix together shredded sludge and soil. Too, they discharge directly into trucks or wagons or onto stock piles.

Write for Bulletin 140 showing the 12 electric, gasoline and belt-to-tractor driven portable and stationary models and giving information on the marketing of shredded dried sludge.

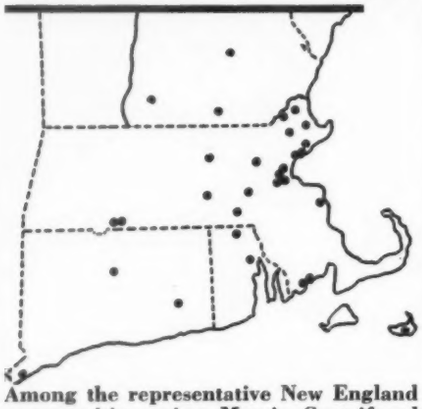
THE ROYER

ROYER FOUNDRY & MACHINE CO.
170 PRINGLE ST., KINGSTON, PA.

The MORRIS HYDRAULIC COLUMN

News of interest to Centrifugal Pump Users

New England is dotted with Morris installations



Among the representative New England communities using Morris Centrifugal Pumps are:

City of Boston, Mass.
" " Chicopee, Mass.
" " Concord, N. H.
" " Dover, N. H.
" " Haverhill, Mass.
" " Hartford, Conn.
" " Keene, N. H.
" " Lynn, Mass.
" " New Bedford, Mass.
" " Newton, Mass.
" " Providence, R. I.
" " Springfield, Mass.
" " Waterville, Maine
" " Woonsocket, R. I.
" " Worcester, Mass.
Town of Amesbury, Mass.
" " Andover, Mass.
" " Bristol, R. I.
Town of Brookline, Mass.
" " Concord, Mass.
" " Fairhaven, Mass.
" " Framingham, Mass.
" " Ipswich, Mass.
" " Milford, Mass.
" " Millford, N. H.
" " Milton, N. H.
" " Nahant, Mass.
" " Nantucket, Mass.
" " Raymond, N. H.
" " Saugus, Mass.
" " Scituate, Mass.
" " Warren, R. I.
" " West Springfield, Mass.
Waterville, M., District
Metropolitan District
South Essex Sewerage Dist.

In New England, as in every other section of the country, many are the communities which can testify to the high efficiency, dependable service and low maintenance expense of Morris Centrifugal Pumps for water supply, sewage, storm water drainage and general plant services.

Morris Pumps are notable for their high efficiencies, sometimes exceeding 90% in favorable operating conditions. Installations can be arranged to include special features such as vacuum priming systems to reduce the suction head, withdrawal of air from impeller suction openings, automatic operation and control, etc.

Write for bulletins describing features of design which explain why Morris Pumps are preferred by so many water department superintendents and engineers.

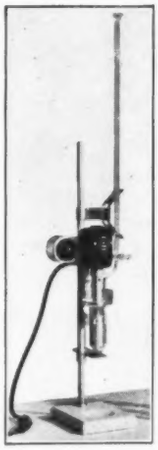
MEMBER

For authoritative recommendations on any pumping or dredging problem, write to Morris Machine Works, Baldwinsville, N. Y. Representatives in principal localities. *Export Office*, 50 Church St., New York.

EQUIPMENT NEWS

Langelier Water Hardness Apparauts

● Professor W. F. Langelier, in the February 1940 issue of the A.W.W.A. Journal described his interesting apparatus for the determination of the hardness of water samples under the title "A Motorized Apparatus for the Rapid Determination of Calcium and Magnesium in Waters." Now, this novel piece of laboratory apparatus, here pictured, is being produced for distribution by Chemlab Specialties Co. of Berkeley, Calif.



The Langelier Water Hardness Apparatus is designed to speed up the hardness titration appreciably; and, more importantly, to insure accuracy of determination by eliminating the laborious hand shaking and the tedious end-point which entails a deal of personal interpretation (if not guessing) in deciding when the exact end-point has been reached. The new equipment permits an entirely new technique wherein the end-point is sharply and unmistakably indicated by the pronounced light obstructing qualities of air emulsified in water. With the improved method calcium and magnesium hardness can be determined separately.

The titrating medium is a cold-water soap of *definite* composition—potassium oleate—which is made fluorescent for the purpose of increasing visibility of the meniscus in the burette. A buffering reagent is added to adjust the pH of the titrated sample automatically, and thus eliminate errors due to low pH values and, also, interfering ions other than the hydrogen ion.

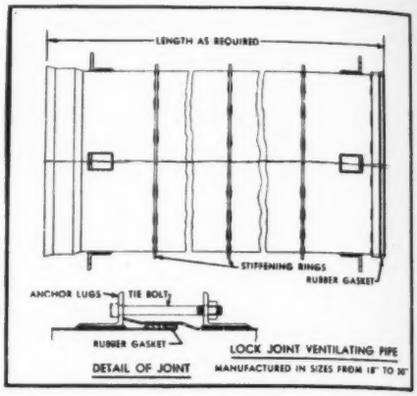
The single sliding support for the titrating unit, permits ready adjustment of the titrating cup to the motor propeller. The burette is always in proper position. Each unit is supplied *complete*, ready for use on 110 V.A.C. or D.C. with lamp; motor speed controlling rheostat; titrating cup; burette; 32 oz. of standardized soap solution; 8 oz. of buffer reagent; and, a book of complete instructions, containing also a useful standardization table.

For an illustrated folder, containing more of the details, write Chemlab Specialties Co., 52 Alvarado Road, Berkeley, California.

Improved Tunnel Ventilating Pipe by Lock-Joint

● Lock-Joint Pipe Co. of Ampere, N. J., announces a new and improved type of pipe for ventilation work, whether involving forced air or suction.

A particular feature of the new pipe is the joint, designed for ease in centering and connecting sections, and for air-tightness. Constructed as a steel tube of light weight, these pipes are



designed to withstand partial vacuum as well as positive pressures. Another feature is the resulting smooth surface of the bore and low-friction jointing, which makes for minimum pressure losses, and therefore air blowing economy. Still another, is the ease of dismantling and re-assembly in moving the pipe on the job.

An announcing folder states that the improved Lock-Joint Ventilating Pipe has been extensively and satisfactorily used by five contractors on 35 miles of the new Delaware Aqueduct Tunnel, now under construction for the New York City Board of Water Supply. For further details address Lock-Joint Pipe Co., Ampere, N. J.

"HYDROFLEX," AN UNDERWATER PAINT

● "Hydroflex" is a paint especially developed by the Phelan-Faust Paint Company of St. Louis for finishing under water surfaces, such as swimming pool floors and walls, fountain basins, fish or lilly pools and tanks in general, shower rooms and concrete floors in general.

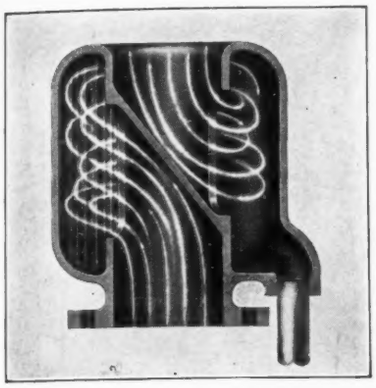
One of the chief qualities claimed for "Hydroflex" is its resistance to chemical attack, even strong alkali solutions (up to 5%) not marring its luster and color. In addition, the rubber like texture of the film, which bonds with the concrete, renders it resistent to abrasion. It is recommnded as an excellent floor paint, and especially for damp basement walls and floors, or sweaty ceilings. It is fade resistant to sunlight and the producer claims that algae have a difficult time adhering to the glass like surface of "Hydroflex," and iron stains are readily scrubbed off when they appear.

"Hydroflex," with a covering capacity of 250 to 300 sq. ft./gal., is not a cheap paint but, on long term demonstrations of lower maintenance expense is claimed to be an exceedingly economical finish.

A neat booklet is available which presents the merits, of "Hyroflex," conpresents the merits, of "Hyroflex." For a copy, write The Phelan-Faust Paint Mfg. Co., St. Louis, Mo.

Cochrane Exhaust Heads Available in 8 Sizes

● The Cochrane exhaust head insures the separation of condensate and oil from steam discharged to atmosphere and thereby prevent raining of water and oily condensate upon the roof or ground below, at the same time discharging clean, dry steam noiselessly.



The new exhaust head incorporates the principles of the Cochrane baffle-type separators used for removing oil and moisture from steam lines. Exceptional port area produces low steam velocity and minimizes pressure loss. Steam is whipped sidewise and causes projection of the entrainment against ribbed baffle surfaces. The high ribbed baffles exert a scrubbing action in addition to the centrifugal purging force. The exhaust head is of one piece semi-steel construction for 4 to 12 inch sizes and of welded plate for larger sizes. Publ. 2960 recently revised with installation photographs, contains complete engineering data, dimensions, and list prices. For a copy write to Cochrane Corporation, 17th St. and Allegheny Ave., Philadelphia, Pa.

Spreader for Coppering

● The Water Department of Los Angeles has demonstrated the economy and effectiveness of applying copper-sulphate in pulverized form to the *surface* of reservoirs being treated for systematic algae control. In this same general direction San Francisco has developed the surface application through use of spray nozzles for spreading a solution of the salt. Both methods are far superior to the wasteful method of dragging bags of the salt through the water.

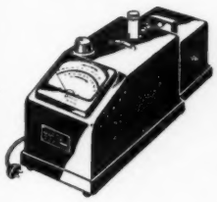
The here pictured dry Copper Sulphate Spreader is the outcome of the pioneering development of the process and equipment by R. F. Goudey and others of the Los Angeles Water Department. In its present state of perfection the machine pictured is the product of the Utility Fair Corporation.

Leading Apparatus

for the WATER WORKS *and* SEWERAGE LABORATORY

The HELLIGE TURBIDIMETER. Turbidity measurements (SiO_2) and sulphate determinations can be made with greater simplicity and speed *without* the preparation and use of standard suspensions. Reads all turbidities down to zero.

HELLIGE COMPARATORS are unsurpassed in durability, handiness, and convenience. Perpetually accurate glass standards are available for pH control and all popular A.P.H.A. and A.W.W.A. methods.



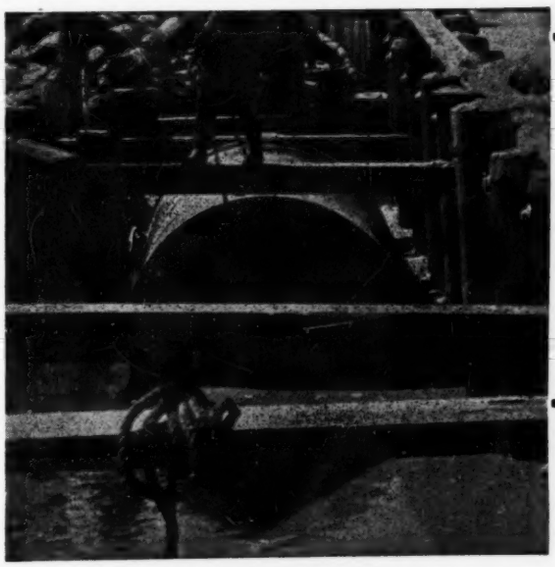
The HELLIGE - DILLER PHOTOELECTRIC COLORIMETER is a precise photoelectric instrument for accurate and *always* reproducible colorimetric determinations. No standards required. Ideal for the determination of minute quantities of phosphorus, silica, sulphates, chlorides, and dissolved oxygen.

HELLIGE GLASS ELECTRODE pH-METERS—COUNTING APPARATUS—COUNTING CELLS AND MICROMETERS.

Write today for informative 28-page bulletin No. 602.

HELLIGE, INC. 3718 NORTHERN BLVD. LONG ISLAND CITY, N.Y.

HEADQUARTERS FOR COLOR STANDARDS AND COLORIMETRIC APPARATUS



84" pipe—Spring Lake, N. J.

FLANGED PIPE

FLEXIBLE JOINT PIPE

BELL & SPIGOT PIPE

SPECIAL CASTINGS

SHORT BODY BELL & SPIGOT SPECIALS

Large stock enables us to make prompt shipments.

CAST IRON PIPE

SIZES 2" TO 84"

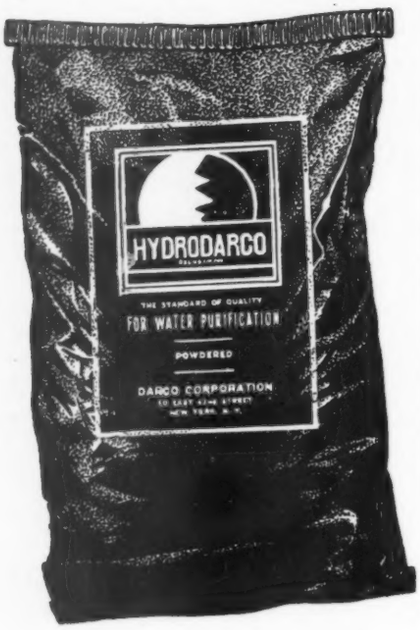
Warren Foundry & Pipe Corp.

11 Broadway, New York

Warren Pipe Company of Mass., Inc.

75 Federal St., Boston

TEST THE PERFORMANCE



...AND PROVE THE VALUE!

HYDRODARCO — the activated carbon specially made for water treatment — gives you ***maximum*** palatability control per dollar. Prove it to your own satisfaction . . . through the Threshold Odor Test, the Carbon Feed Chart, and the Darcograph. Ask us about these scientific, simplified methods for checking carbon performance. We will send full details—plus a sample of Hydrodarco.

Hydrodarco Reg. U. S. Pat. Off.

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New York	Buffalo	San Francisco
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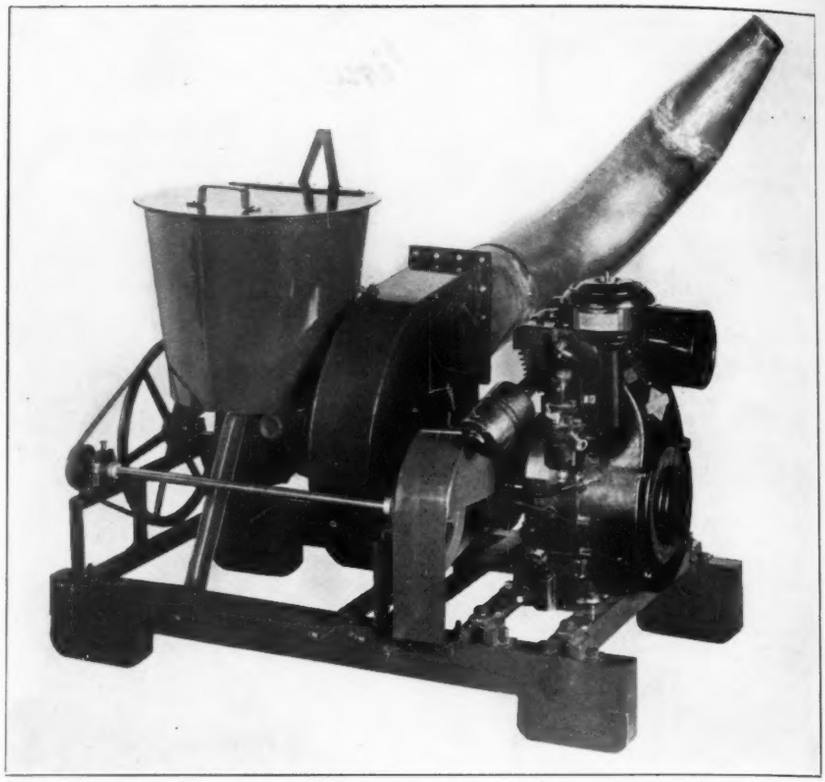
DARCO CORPORATION

60 East 42nd St., New York, N. Y.



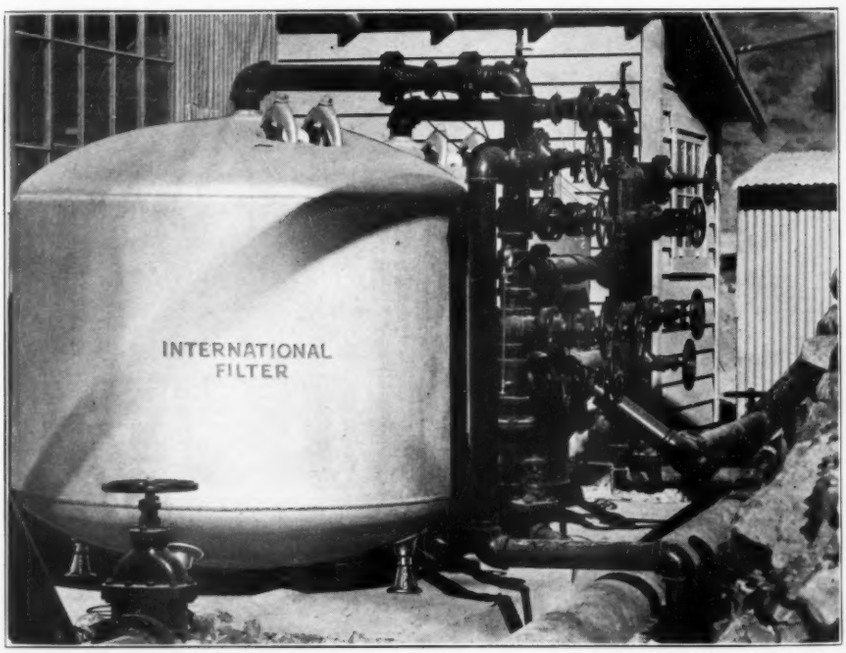
Its over all dimensions of 46½x25x32 inches in height are such that it can be readily installed in a boat of practical size for the shallow shore-line work.

In its operation one man keeps the hopper loaded and regulates the spout angle for best distribution, and rate of feed. The spout setting is adjustable to wind velocities up to 30 m.p.h. winds. The rate of feed is varied to meet wind conditions, speed set for the boat travel, and pounds per acre of copper sulphate required for the job at hand.

The Utility Spreader may of course be used for spreading other materials such as high-test hypochlorite powder, activated carbon (recently employed as an "algae black-out" scheme by the floating carbon film route), lime or any other chemical which may be desired. It comes fully equipped with gasoline drive motor as pictured.

For further details write the Utility Fan Corpn., Los Angeles, Calif.

"Simplex" Adjustable Tank Supports



● The application of screw type jacks as height adjusting and levelling legs for tanks and filters seems like such a "natural" that one wonders why this

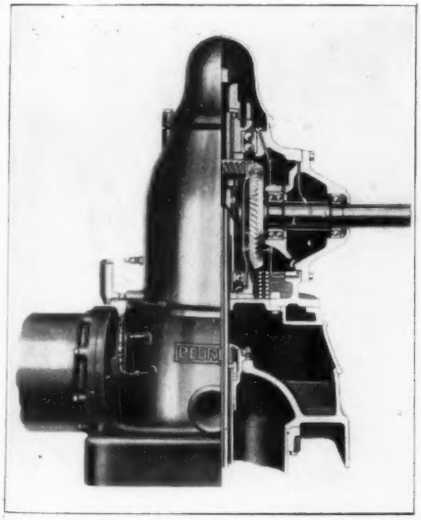
development has not much earlier come to pass. The method seems like simplicity itself and hence the name of these adjustable tank legs—"Simplex" —is fitting.

Templeton, Kenly & Co. of Chicago, who are reported to be "The World's Largest Manufacturers of Jacks" have recently announced the "Simplex" Adjustable Tank Supports. These units are merely the well known "Simplex" Screw Jacks specially designed for the purpose and equipped with head saddles to conform to the rounded surface of tanks, pressure-filters, softening units, etc.—(See cut.)

The advantages cited for such trim Adjustable Supoprts include claims of: (1) Lower first cost and final cost in setting and maintaining the unit supported; (2) Ease of exact levelling and bringing connecting pipe flanges to an exact meet; (3) Neatness and ability to keep space beneath tanks and filters clean; (4) Better floor ventilation; (5) Especially advantageous for units which may be later moved; (6) Horizontal tanks completely drainable by adjustment of legs to establish bottom gradient.

For further details request Form 41, an 8-page illustrated bulletin containing complete specifications and engineering data pertaining to these "Simplex" Adjustable Tank Supports and Saddles. Address Templeton, Kenly & Co., 1020 South Central Ave., Chicago, Ill.

Improved Gearturbo Pump Head



● Improvements in the design of geared heads for deep well turbine pumps have been announced by Peerless Pump Co.

Development of the 1941 models include a change in bearing application. The take-off shaft is designed to carry increased loads. Double-row ball bearings support the horizontal and vertical shafts and are placed adjacent to the spiral bevel gears. An extra heavy duty thrust bearing supports the lower end of the geared shaft sleeve, while

BUILDERS
Kennison Nozzle — OPEN FLOW

AN IDEAL METER FOR THE SMALL SEWAGE PLANT!

Simple, economical, accurate and trouble-free, the Kennison Nozzle measures raw sewage, sludge or effluent. Ask for Bulletin 308.

Among the 1940 Kennison Nozzle installations is Monson State Hospital, Mass., illustrated.

Bayard F. Snow, Engineer

BUILDERS . PROVIDENCE
IRON FOUNDRY RHODE ISLAND

SUPERINTENDENTS — ENGINEERS — PLANT OPERATORS
Your First Line of Defense

ISCO
FERRIC CHLORIDE
for Sewage Treatment

FERRIC CHLORIDE

FOR SLUDGE CONDITIONING—Ferric chloride is a most efficient agent, from the standpoint of performance and economy.

FOR COAGULATING SEWAGE—Ferric chloride has been found by many treatment plants, both large and small, to be the most effective coagulant for chemical treatment of sewage.

Write for booklet containing valuable information.

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If you appreciate
SAVING
IN YOUR PIPE JOINTING

Using *Tegul*-MINERALEAD for your Bell & Spigot Main Jointing, you save in Time, Trouble, Labor . . . and Money, too! • Quick sealing of initial leakage speeds the job • Skilled labor is not needed and storing *Tegul*-MINERALEAD outdoors you'll have no weather worries • It works with all diameters up to 48"—and larger if required • Joints are permanently tight and offer extraordinary resistance to thermal and mechanical shock • The first step to these savings and advantages is to write for more information • Address The ATLAS MINERAL Products Company of Pa., Mertztown, Pennsylvania.

Tegul-MINERALEAD

The INGOT FORM Jointing Compound for Bell and Spigot Main

an additional thrust bearing supports the outer end of the horizontal drive shaft. All four bearings are lubricated by an oil pressure system which circulates cooled oil to both bearings and gears.

To prevent leakage of oil from the outer bearings on the take-off shaft, an oil seal is placed on the end of the bearing housing. This seal is equipped with an annular garter spring and the treated leather element is oil-resistant. Annealed semi-steel castings are employed to insure against distortion and misalignment of gears and other moving parts.

The head assembly is streamlined and the gearing is completely housed for protection against the elements. The gears are heat-treated, hardened and ground nickel alloy and lapped for specific operating tooth capacities. Standardized speed ratios of 1 to 1, 1⅓ to 1, 1½ to 1, and 2 to 1 are provided. The head, known as the "Gearturbo," provides for connection with universal shaft to gas engines, steam engines and any other power unit.

Further details may be obtained from the Peerless Pump Company, 301 West Avenue 26, Los Angeles, Calif.

An Improved Pipe Cutter

● A new and improved pipe cutter is marketed under the trade name "Ridgid" No. 42—a product of The Ridge Tool Co. of Elyria, Ohio.

Its stocky design and short handle makes it especially suitable for work in close quarters. For increased cutting speed at moderate pressures, it is equipped with 4 cutting wheels. This feature provides better balance and insures a more even cut of iron, steel or brass pipe. For details or catalog and prices, write The Ridge Tool Co., Elyria, Ohio.

Modern Truck Fleet by Federal

● Since garbage and sewage disposal are becoming more closely linked all the time, readers of this magazine will probably be interested in the above pictured modern garbage and rubbish truck fleet recently supplied Schenectady, N. Y., by the Federal Motor Truck Co., of Detroit. (Nice view of Schenectady's City Hall also.)

Federal, in supplying this picture, points out that trucks doing garbage and rubbish pick-up duty are submitted to a peculiar service of a continuous start and stop nature which requires special design and performance consideration for "hard-going." For such service Federal supplies a complete series of medium to heavy duty models (including Cab-Over-Engine types) starting at the ¾ ton unit and going to the heaviest.

Federal claims amongst other things for its 1941 truck design—unexcelled maneuverability, new ease of handling and increased visibility, conducive to safety, speed of handling, more operator comfort and less fatigue. If interested in trucks of any description get in touch with Federal Motor Truck Co., Detroit, Mich.

WITH THE MANUFACTURERS

Activated Alum Now Agents for Tate

Process of Water Main Rejuvenation Expansion Includes New Office in Charlotte

Fred Stuart
(by Bachrach)

● Fred E. Stuart, President of Activated Alum Corporation, has recently mailed out an interesting brochure telling of the remarkably rapid acceptance of the Palmer Filter Bed Agitator by small as well as large plants. And, at the same time, announces the recent appointment of Activated Alum as agents for the Tate Linings Co. of Andover, Mass., who have the American rights and control patents covering the Tate Pipe Lining Process which is applied to water mains in place.

The Tate Process is a water main rejuvenation process in which tuberculation and scale is first removed in a main-cleaning operation; and, thereafter a smooth protective cement lining is applied without disturbing the main in its position and with only a brief out of service period involved. The process seems now to need no further proof of its practicability, since its application to several important systems—interestingly to more privately owned than municipally operated systems.

Activated Alum will act in further introducing and advancing this method of recovering original capacity of tuberculated mains, and permanent protection against further interior depreciation. To more effectively perform this service, and other services in connection with their coagulants, activated carbon and Palmer Filter Agitators. Activated announces also the establishment of an office in Charlotte, N. C.

The new office of Activated Alum Corp. is located in Suite 1217, Liberty Life Bldg., Charlotte, N. C., and will be in charge of Mr. Burt Graham.

Columbia Opens New Office in Charlotte, N. C.

● W. I. Galliher, Director of Sales of the Columbia Chemical Division, Pittsburgh Plate Glass Co., announced today the opening of a new chemical sales office at 615 Johnston Building, Charlotte, N. C.

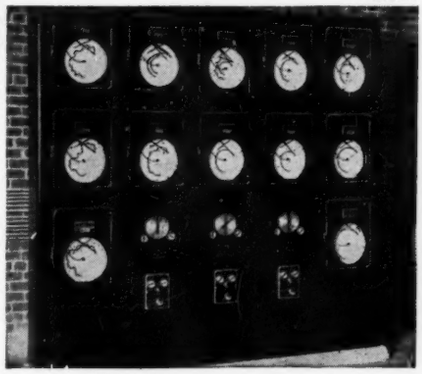
James R. Simpson, former Director of Duke University's Appointments Office, has been named District Sales Manager in charge of the Charlotte Office.

THE *Bailey Synchro-Meter* GIVES YOU *Flexibility* IN METERING APPLICATIONS

● This meter panel includes both direct mechanically operated Fluid Meters and Bailey Synchro-Meters, which are electrically operated by remote transmitters.

Wherever you have need for a central meter panel incorporating both mechanically and electrically operated Fluid Meters, it is possible to maintain uniformity and neatness by employing this system of transmitting meter and recorder readings.

MU-17



Readings of flow, pressure, temperature, liquid level and other factors are accurately and quickly transmitted from out-of-the-way places to the receiving indicator, recorder or integrator by the Bailey Synchro-Meter.

This electrical mechanism which is completely described and illustrated in Bulletin No. 194-A, can also be used to eliminate the necessity of running high pressure piping up to meter and control panels.

Write for your copy of this new Bulletin.

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SEWER CLEANER
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Spherical or bullet types for efficient storage of digester gas under pressure in sewage treatment plants. Any size—any metal—designed to meet your specific requirements. An experienced P-DM engineer will gladly consult with you, without obligation.

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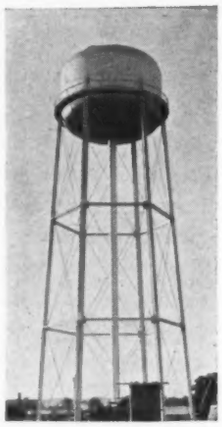
RUSTOP saves your tanks from costly corrosion



RUSTOP, *the cathodic system of corrosion prevention, reduces maintenance costs and prolongs the life of your tanks indefinitely.*

Entirely automatic; functions in cold or warm weather; protects tank and riser; old or new tanks without special preparation. Let us quote you on stopping rust in *your* tanks.

ELECTRO RUST-PROOFING COMPANY

29 W. Apple St. Dayton, Ohio

Col. Rockwell Named on Important National Committee

Rockwell Elected to National Committee on Business Welfare

● Colonel W. F. Rockwell, President of the Pittsburgh Equitable Meter Co., and Merco Nordstrom Valve Co., has been elected to serve on the National Committee on Business Welfare. This committee has been established by the Chamber of Commerce of the United States to further the aims of the National Chamber through many broad objectives designed to solve serious problems affecting business and the general welfare.

Through his close contact as a director and an officer in several large companies whose interests are widely diversified, the Colonel is in a position to give valuable assistance to the new Committee.

Wm. A. Cather Joins Michel Firm

● Announcement has been received that William A. Cather, former Advertising Manager for the Babcock-Wilcox Company, has been made Vice-President of what is now Michel-Cather, Inc., of 2 Park Avenue, New York City.

The new firm retains the name Michel in honor of the late founder of A. Eugene Michel and Staff, Inc., whose traditions and policies will be carried on.

THE NATIONAL METHOD — BEFORE CLEANING — AFTER CLEANING

CLOGGED PIPES

Made Good as New

THE NATIONAL METHOD OF WATER MAIN CLEANING makes your old pipe practically as good as new. Every department is subject to loss through the ravages of time upon its distribution system. The cleaning out of this foreign matter inevitably leads to increased pressure and flow, improved health conditions, and lowered operating costs.

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- saves time, labor, cost of material on the job!
- makes a good, tight joint that improves with age!
- has jointed more miles of cast iron water mains than any other melted self-caulking material.

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EDSON'S NEW HAND PUMP

Smallest Diaphragm Pump Made, 2" Suction Open Discharge. Capacity 1400 G.P.H. Weight 50 lbs.

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Catalog "T" Gives Full Data, Also Edson Hand and Power Pumps, Suction Hose and Pump Accessories

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Your SEWAGE effluents are high in suspended solids;

Or, you have a WATER PROBLEM;

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Or, you are disturbed by STREAM POLLUTION;

Or, are in any way interested in the removal of suspended solids from liquors;

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Laughlin Modified Rapid Sand Filter

BECAUSE, it is a simple automatic, continuous flow apparatus, designed on familiar lines, to accomplish a purpose without adding to the operator's troubles.

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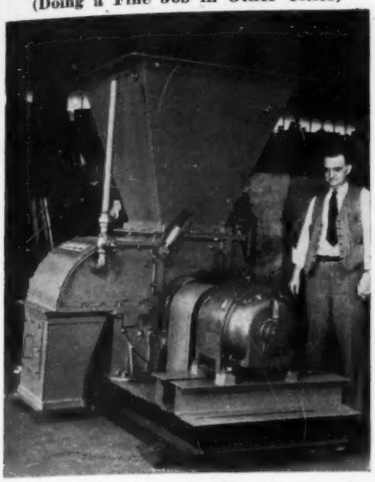

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Embodies an outstanding patented feature which enables it to *handle rag stock* and similar materials *without choke down*, so as to pass through Screen Bar.

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J. C. Merwin Becomes Chain Belt's President

J. C. Merwin

● At the annual meeting of the Board of Directors of Chain Belt Company, J. C. Merwin, Vice-President and Treasurer, was elected President of the Company to succeed C. R. Messinger, who died February 4th. G. M. Dyke, Assistant Treasurer, was elected Treasurer and A. F. Kessler, also an Assistant Treasurer, was elected to the new office of Comptroller.

Mr. Merwin joined the Chain Belt organization in 1917 and has been successively superintendent, works manager, assistant to president, director, vice-president and treasurer. He is a graduate of Sheffield Scientific School of Yale University, class of 1910, and began his business career as an apprentice tool maker.

Both Mr. Dyke and Mr. Kessler have been connected with Chain Belt Company since 1923.

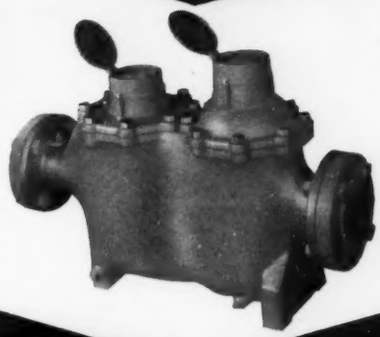
D. S. Mix Now Responsible for G-E Media and Publishers' Relations

● The assignment of responsibility to D. S. Mix for Media and Publishers Relations in General Electric's Publicity Department, Schenectady, has been announced by R. S. Peare, Manager of Publicity.

A native of New Haven, Conn., Mr. Mix was graduated from Yale University in 1917, joining the Publicity Department of G-E immediately thereafter. He was subsequently given responsibility for directing the advertising and sales promotion activities of a large number of G-E apparatus lines.

Under his new duties, Mr. Mix will have responsibility for the work formerly handled by the late Fred R. Davis.

PITTSBURGH ARCTIC-TROPIC COMPOUND METERS



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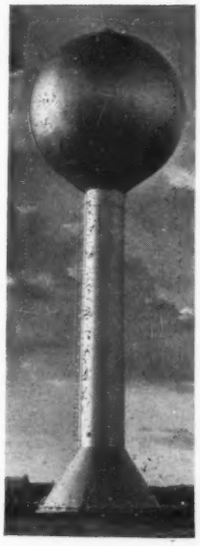

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Simplex Appoints New Maryland-D. C. Agent

● Everett M. Jones, Sales Manager for Simplex Valve and Meter Company of Philadelphia, announces the appointment of Mr. George Goodman, of Baltimore, Md., as the Company's exclusive representative for Maryland, the District of Columbia, and Northern Virginia.

Mr. Goodman, who for a number of years was associated with the New York Office of the Brown Instrument Company, has had wide experience in "instrumentation" and is a worthy addition to the Simplex organization. His office is located at 3903 Park Heights Ave., Baltimore.

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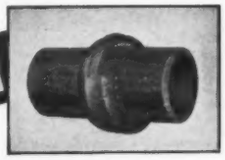
WESTON



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- **Definite space in each joint for cement.**
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- **Particularly advantageous in water-bearing trenches.**
- **Infiltration minimized.**

L. A. WESTON **Adams, Mass.**

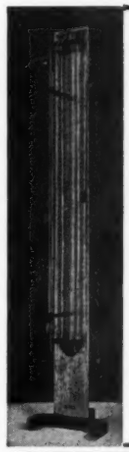
Connelly "Iron Sponge" Co. Makes Extensive Additions

● Connelly Iron Sponge & Governor Company of Chicago and Elizabeth, New Jersey, announces extensive additions and improvements in its production facilities for the manufacture of governors, regulators, back pressure valves and other devices used in the production, distribution, control and consumption of manufactured and natural gas. Contracts have also been let for building a new laboratory and enlarged office space, necessitated by increased demands on the gas purification division.

Mr. A. L. Smyly, president of Connelly, is quoted as saying:

"This expansion of our facilities has literally been forced upon us due to greatly increased demand for our products since the engineering department radically re-designed the entire line about a year ago."

The expansion requires a new laboratory and enlarged facilities in the gas purification division.



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Base weighing 12 pounds can be removed, permitting wall mounting. Well constructed throughout. Art Metal Finish.

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Outstanding features are quick feed adjustment, visible valves, flexible cylinders; feeds against 150-lb. pressure, and proof against corrosive chemicals.

Motor driven, positive displacement, pump type feeder. It is illustrated as a constant rate feeder though also furnished as Type MD-H with fluid meter control, and when so arranged is a measure-to-measure proportioning feeder.
This is a sturdy, dependable heavy duty feeder.

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Monitor Covers are made for 24", 30" and 36" tile. All sizes have 20" lids and can be provided with inner lids if desired. These covers are well adapted for setting large meters.

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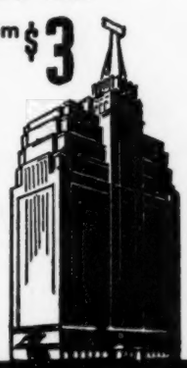

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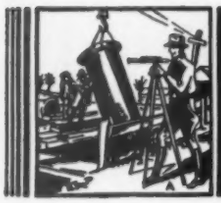

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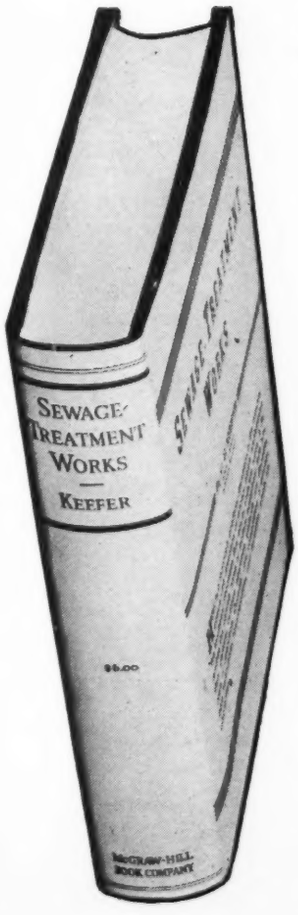

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Administration and Operation

By C. E. KEEFER

Bureau of Sewers, Baltimore, Maryland

673 pages, 6 x 9, 177 tables, 167 diagrams, charts, graphs, and illustrations, $6.00

This practical manual comprehensively presents the problems of administration, operation, maintenance and design of sewage-treatment plants, and how to handle them.

Drawing upon actual operating results and experience obtained at a large number of outstanding sewage works, this book covers sewage treatment in a thorough and practical manner—from characteristics and composition of sewage, through the various stages of treatment, to its eventual disposal.

Its 32 fact-packed chapters present facts about quantity and composition of sewage from institutions, municipalities and industrial plants in considerable detail to facilitate sewage analysis and application of proper treatment processes. Modern apparatus and new methods developed over recent years are discussed in detail for the first time in any book.

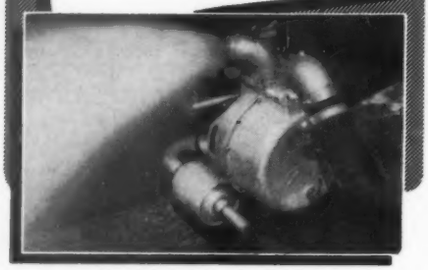
Read the review of Mr. Keefer's book by W. D. Hatfield of Decatur, Ill., which appears on page 105 of this issue.

Water Works and Sewerage

330 South Wells St., CHICAGO — 155 East 44th Street, NEW YORK

They DISH IT OUT and they can take it too

HOMELITE PORTABLE PUMPS



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Send for bulletin.

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HOMELITE CORPORATION

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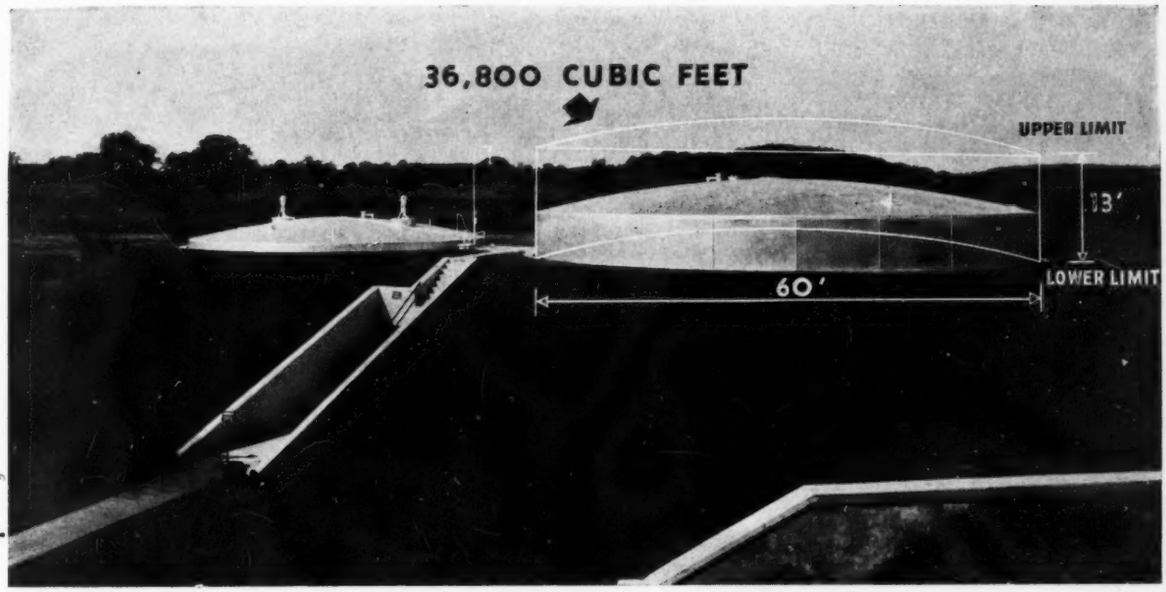

A typical Dorr Multdigestion System, showing range of the gas holder on the 60 ft dia. secondary tank.

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- A combination cover and gas holder that provides ample gas storage.

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